

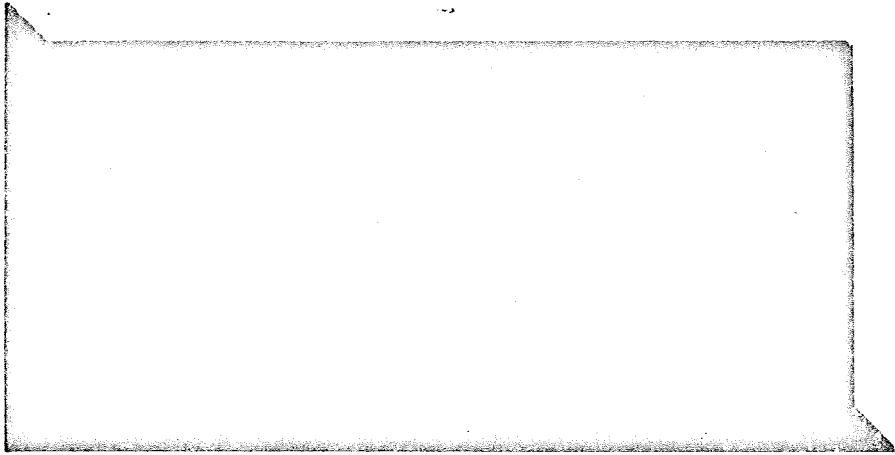
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(NASA-CR-151313) INTEGRATED MEDICAL AND  
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INTEGRATED MEDICAL  
AND  
BEHAVIORAL LABORATORY  
MEASUREMENT SYSTEM  
  
PHASE B FINAL REPORT  
VOLUME II - MANAGEMENT  
  
CONTRACT NASW-1630

PREPARED FOR THE  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
  
BY THE  
MANNED ORBITING LABORATORY DEPARTMENT

GENERAL  ELECTRIC

RE-ENTRY SYSTEMS DEPARTMENT  
*A Department Of The Missile and Space Division*  
3198 Chestnut Street, Philadelphia 4, Penna.

# VOLUME II

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SECTION 1  
INTRODUCTION

## SECTION 1

### INTRODUCTION

In response to the requirements of both the Phase B Work Statement and good practices, a series of management plans for conduct of an abbreviated Phase C program has been prepared and is submitted in this volume. The plans submitted and their contents correspond to those required by the Work Statement, as interpreted by General Electric.

These plans are drawn up based on the concept of a relatively small, closely-knit management and technical team supported as required by functional specialists and carrying out the preliminary design and planning for a high-quality hardware program. Using this concept, many management and planning activities (which in the large Phase D hardware program must be carried out on formalized even computerized basis) will be accomplished through the close communications and intimate involvement which a team permits. Generically, all needed activities and controls are present; the degree of formality and stylized activity is minimized commensurate with proper output and documentation.

SECTION 2  
PROGRAM PLAN

## SECTION 2

### PROGRAM PLAN

#### 2.1 INTRODUCTION

##### 2.1.1 PURPOSE AND SCOPE

This Program Plan is in direct response to the requirements of Article II, Statement of Work, Section H.1. This document provides preliminary definition of the planning and management approaches to be used in the "Phase C - Design" effort. This Plan summarizes and inter-relates all of the plans described in Sections H-2 through 8 as well as provides an overview of the total Phase C Program.

The Program Plan is to be a working document issued and revised throughout the life of the program to reflect planning based on current program status and changing customer requirements. Revision is to be made only after coordination with affected organizations.

This document provides uniform guidance and direction to all organizational elements and people committed to the program. It ensures that all tasks and subtasks included in the Contract Statement of Work are being pursued; it establishes master schedules against which more detailed schedules can be effectively and consistently developed; provides in summary form the allocation of resources including money, manpower, equipment, and facilities; establishes the management structures for the program and assigns responsibility for work and the level and number of persons assigned to the Program; it also defines policies, procedures and methods governing all program activities. The integration of these various factors results in a common understanding of contract requirements and a concerted uniform approach to the management of the program.

##### 2.1.2 OBJECTIVES OF THE PHASE C PROGRAM

The objective of the Phase C program is to design the IMBLM System to meet the requirements as defined in "System Requirements" in Section 3.2 in Volume III of this report. The Phase C final report will document the preliminary design and associated efforts of this phase and define and propose the Phase D activity. The Phase C IMBLMS end products will include:

- a. Requirements Documentation Package
- b. Preliminary CEI Specifications for all prime and support equipment
- c. Procurement specifications and associated control drawings
- d. Drawings for Modules, Subsystems, Systems, and support equipment
- e. Preliminary test specifications

- f. Preliminary reliability predictions and analyses
- g. Planning for Phase D
- h. Preliminary Safety Hazards analysis
- i. Definitive Work Statement and Cost proposal for Phase D.

### 2.1.3 RATIONALE UNDERLYING PREPARATION OF FUNCTIONAL AND MANAGEMENT PLANS

The following points were taken into consideration in the formulation of the functional and management plans for the Phase C portion of the IMBLMS program.

- a. Phase C is expected to be a design effort on the order of \$1 Million, with no hardware delivery involved. Operating procedures developed for multimillion dollar programs will not be required for a program of this size.
- b. This system is to be a part of a large program and will therefore require certain procedures and forms for reporting in order to provide smooth integration and information flow with the other portions of the program, especially the Spacecraft Contractor and the NASA Headquarters and Manned Spacecraft Center.
- c. A design program of this size has relatively short lines of communication and can therefore depend on the program personnel to be more effective in communicating and following through in all tasks related to the program - specifically, the Program Manager and the Engineering Manager can expect to keep very close to the day-to-day activities of the program.
- d. The support organizations and services of the Departments and/or Division will be used selectively and judiciously in order to maintain responsibility and control within the IMBLMS program.

### 2.1.4 COMPLIANCE AND GUIDANCE DOCUMENTS USED

#### 2.1.4.1 Compliance

NASA - RFP 10-1243, IMBLMS, December 27, 1966 (Compliance modified by proposed abbreviated Phase C in lieu of Phase C as described).

NPC 500-1 Apollo Configuration Management Manual (in portions, otherwise guidance)

MIL-D-1000, 1 March 1965

MIL-STD-100, 1 March 1965

#### 2.1.4.2 Guidance

NPC 500-6 Apollo Documentation Administration Instructions

NPC 250-1 Reliability Program Provisions for Space Systems Contractors, July 1963

NPC 200-2 Quality Program Provisions for Space Systems Contractors, April 1962

NPC 500-10 Apollo Test Requirements Document, August 1964

Saturn/Apollo Application Program Technical Summary - OMSF, September 1, 1966

SID 65-1536 and Design 378-B - Experimenter Design Guide

NASA Working Paper No. 10,065 Orbital Workshop, MSC, Experiment Requirements

AFSCM 375-5 System Engineering Management Procedures

MD-E-8020-008B Natural Environment and Physical Standards for Apollo Program

### 2.2 SUMMARY

#### 2.2.1 PLAN FOR DEFINITION OF IMBLMS

In Phase C (abbreviated) General Electric plans to build from an update of Phase B study results to accomplish IMBLMS definition. The general plan encompasses the following.

##### 2.2.1.1 Technical

###### 2.2.1.1.1 Requirements

Initially, will update and refine Phase B measurement and measurement equipment requirements. Based on this and other inputs and constraints (ex: Spacecraft requirements, etc.) General Electric will prepare a system design requirements document for guidance of all contributors. Subsequently, these requirements inputs will continue to be studied and will be updated judiciously to bring the best available requirements to bear on the preliminary design without nullifying progress made. Included is continuous examination of potential suppliers' contributions.

###### 2.2.1.1.2 Preliminary Design

Based upon these requirements, preliminary subsystem requirements and module identifications will be made, and continuously refined through Phase C. Experiment/Spacecraft/equipment/human interfaces affecting each subsystem and between subsystems will be delineated and documented, allowing specifically for flexibility and growth. Each subsystem preliminary design will be accomplished through use of the above inputs and include tradeoffs of requirements with flexibility, growth potential, development problems, reliability, and safety. In particular, the number of units into which the IMBLMS is assembled will be critically examined in a tradeoff between application flexibility and problems of use (reliability, complexity, etc.). Resulting will be preliminary subsystem specifications, component identifications and specifications and, based upon all the above, reflection of the preliminary design

into preliminary CEI Specifications including flight equipment, ground equipment, computer software and required equipments from the government and from other contractors.

#### 2.2.1.1.3 Analysis and Support

Accompanying and supporting the above efforts are analyses by supporting specialists: reliability, safety, various technologies, human factors, etc; and tradeoff analyses led by system and subsystem lead design personnel. Specialists in safety, reliability, human factors, manufacturing engineering, quality, and many other areas will support this effort.

#### 2.2.1.2 Management

The IMBLMS Phase C effort will be accomplished under the leadership of a close-knit team of selected personnel. Dr. Richard Lawton, M. D. is in overall charge. Mr. A. A. Little, Program Manager, is Deputy to Dr. Lawton for conduct of the program including definition, funding and control of all work and leadership of the Phase D planning. Mr. Gordon Fogal is responsible for all Engineering; Dr. Murray Smyth, M. D. for medical requirements and contributions, and Dr. Ted Marton, Ph. D. for behavioral requirements and human factors. Support from other functions in the MOL Department is provided through designated representatives who report for program matters to the Program Manager. Led by the Program Manager's office, effort to be accomplished is documented in a series of plans which are controlling documents. Control is accomplished through reporting progress versus plan in reports and meetings, and continuous management involvement in and leadership of the work. Key plans are as follows:

#### SEPARATELY PREPARED PLANS

Program Plan - Summary plan for overall accomplishment of Phase C.

Management Plan - Plan for Management of the Program.

Management Control Plan - Plan for control and accomplishment of each task.

Documentation Plan - Plan for generation and control of Phase C documents and generation of Phase D Documentation.

Make or Buy Plan - Plan for phase C make or buy and source selection activities plus preparation of Phase D plan.

Test Plan - Plan for generation of a complete Phase D test plan covering all testing activities.

Reliability and Quality Assurance Plan - Plans for Reliability and Quality Assurance activities in Phase C and generation of Phase D plans.

Specifications Plan - Plan and preliminary specification tree for preparing preliminary CEI and other specifications during Phase C.

## PLANS INCLUDED IN PROGRAM PLAN

Manufacturing Plan - Including manufacturing planning and facilities planning in Phase C, and Phase D plans)

System Safety Engineering Plan - For Phase C activities and Phase D plan.

Logistic Support Plans - Including: Maintainability Plan and Logistics Plan, Phase C activities and Phase D plans.

### 2.2.1.3 Planning

A significant part of the Phase C effort is generation of a group of complete and realistic planning documents for Phase D. For maximum value this effort is accomplished by those managers, technical contributors, and supporting specialists who are directly involved in the work. These planning documents include:

Program Plan (Top, Summary Plan)

Management Plan

Engineering Plan

Integrated Test Plan (Including both Development Test Plan and Qualification Test Plan)

Support Equipment Development Plan

Training Plan

Quality and Reliability Program Plans

Facilities Plan

Make or Buy Plan

Configuration Management Plan (Including Specification Planning)

Documentation Plan

Manufacturing Plan

Logistics Plan

Mass Properties Control Plan

Maintainability Program Plan

Integrated Electrical System Design Plan (Including both Power and Electromagnetic Controls Plans)

Interface Management Plan

Safety Plan

## 2.2.2 METHOD FOR PHASE C WORK STATEMENT COMPLIANCE

An important aspect of the GE Phase C effort is assuring full compliance with the Work Statement, the document which embodies the customer's needs and desires--the reason for the contract. This involves both planning and control.

### 2.2.2.1 Planning

In response to the Statement of Work, full plans for Phase C are laid down.

2.2.2.1.1 The effort required has been translated into a work breakdown structure, the work to be accomplished under each "package" of this structure defined, costed, and scheduled, and products identified to the degree possible in advance.

2.2.2.1.2 For each package of effort, responsibility and accountability (organization and person) is assigned and key contributors identified. Each task either directly or as a part of a higher level task is ultimately the responsibility of one of the team members identified under paragraph 2.1.

2.2.2.1.3 To support and amplify the tasks to be undertaken, a series of plans for specific efforts has been prepared.

### 2.2.2.2 Control

In accomplishment of the above planning to assure that compliance of the Statement of Work in fact occurs, a series of controls is used.

2.2.2.2.1 The Program Manager signs what is in effect a Contract with each responsible contributor for each task for which he is responsible. This "Contract" defines the task, products, schedules, and funding.

2.2.2.2.2 During performance, accomplishment versus plan (technical, schedule, cost) is monitored through:

- Regular reports to and measurements by the Program Manager's office.
- Frequent regular and special meetings to review progress, problems, and planned corrective actions. These include both internal meetings and those involving the customer.
- Continuous involvement by and communications between the key team members, a technique very important in a limited time and funded effort of relatively small magnitude but having large implications by virtue of the results.

2.2.2.2.3 Technical and Management review of all products both in process and before final release, assuring full compliance with the intent.

2.2.2.2.4 Deserving special mention is the control of channels of direction internally to assure action according to the contract: As in-house "customer," the Program Manager assigns all work; he in turn assures that the work is in compliance with Contractural scope as continuously defined and controlled by the Contract Administrator.

## 2.3 ORGANIZATION

### 2.3.1 MOL DEPARTMENT

The General Electric Company has established the MOL Department within the Missile and Space Division, incorporating the most significant manned orbital spacecraft capability that could be assembled with the Company. The IMBLMS team for Phase C and D is established within the MOL Department and members of this team are employed in the Phase B study effort.

Figure 2-1 shows the corporate position of the MOL Department reporting vertically to the President. The MOL Department is advantageously situated within a family of business activities with demonstrated space competence and draws on the Division's resources for skilled manpower and specialized facilities as required for IMBLMS.

#### 2.3.1.1 IMBLMS Program

Reporting directly to the General Manager, MOL Department, is R.W. Lawton, M. D. who is responsible for the IMBLMS Phase B Study and will be responsible for the Phase C Program. Dr. Lawton draws upon the resources of the MOL Department as required for the IMBLMS effort. Figure 2-2 shows the organization and functional responsibilities of each group within the MOL Department. Each major function is headed by a Manager on the General Manager's staff. Additionally, three Directors act as assistant general managers to provide high level management attention on behalf of the General Manager.

#### 2.3.1.2 IMBLMS Organization

The Management Philosophy for IMBLMS is based upon two basic premises.

- a. The organization depends on the job to be done. Thus the organizations for Phase C and Phase D differ from each other.
- b. For maximum effectiveness, a program such as IMBLMS needs both the full-time attention of responsible leaders and key contributors provided by projectized organization and the availability as needed for many specialists provided by other functional groups.

In Phase C the emphasis is on analysis, preliminary design, and planning by a relatively small group of closely knit contributors plus contributions as needed from specialists elsewhere. The Phase C organization is shown in Figure 2-3.

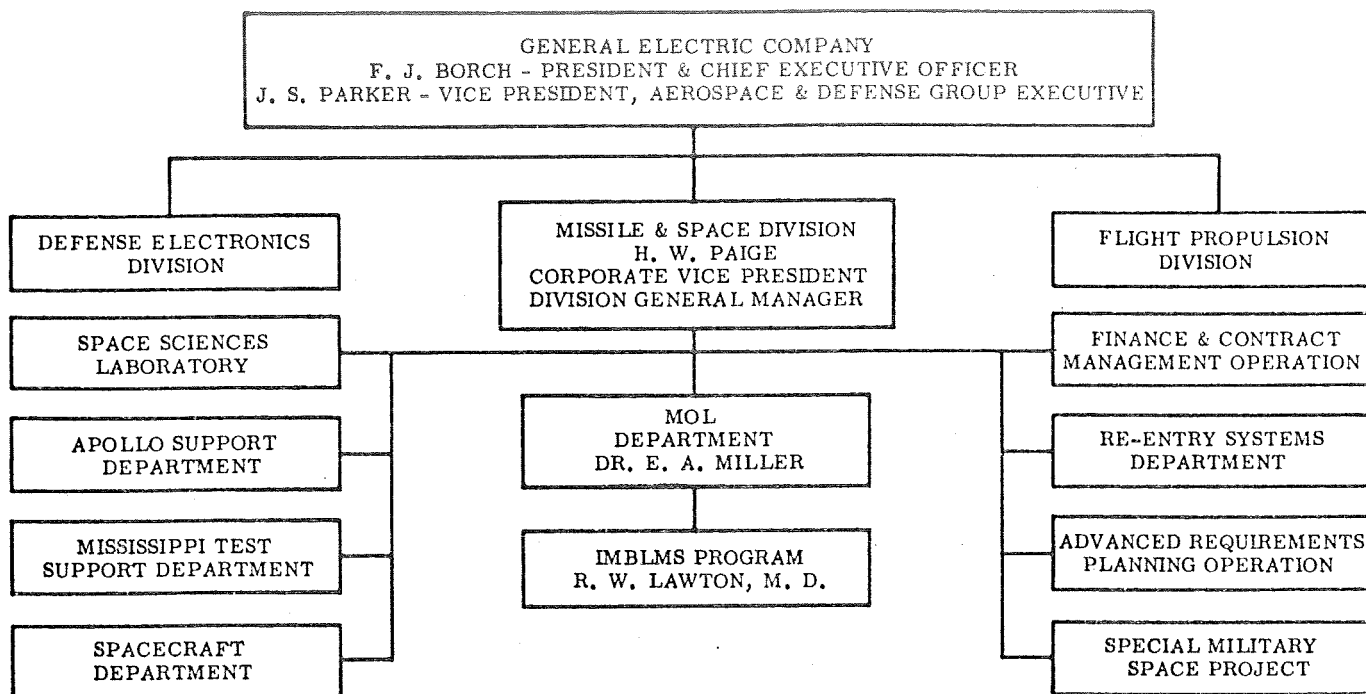


Figure 2-1. MOL Department in the General Electric Organization

- a. The "hard core" team will operate under Dr. Lawton and will largely be physically located in a team area.
- b. The Program Manager will be a part of this team, acting as Dr. Lawton's deputy to conduct the program.
- c. Contributions from other sections will be obtained on an as-required basis; each section has identified key personnel to support the effort directly and draw on the section's resources as required.

#### 2.3.1.3 Role of the Program Manager

The Program Manager and his staff are directly responsible for conduct of the program. His overall functions include:

- a. Translating customer program direction into internal direction.
- b. Assigning responsibilities to and funding of functional operations.
- c. Planning, integrating, measuring and controlling all program tasks.

TECHNICAL OPERATIONS  
OPERATIONS DIRECTOR  
R. A. PASSMAN

PROJECT OPERATIONS  
OPERATIONS DIRECTOR  
O. E. ENDERS

MOL DE  
GENERAL  
E.A.

BUSINESS MANAGEMENT  
SECTION

MANAGER  
A. E. BUESCHER, JR.

RESPONSIBLE FOR THE PROPOSAL, NEGOTIATION AND ADMINISTRATION OF CONTRACTS AND CONTRACT CHANGES; FOR AUTHORIZING EXPENDITURE OF CONTRACT AND GROWTH FUNDS; FOR COMPLIANCE WITH ALL CONTRACTUAL AND PROCUREMENT REQUIREMENTS IMPOSED UPON GE BY THE CUSTOMERS INCLUDING SUBMISSION OF CONTRACT-REQUIRED REPORTS FOR ADVANCED DEVELOPMENT PROGRAM REQUIREMENTS; FOR BUSINESS PLANNING AND MARKET DEVELOPMENT; FOR FORECASTING OVERALL RESOURCE REQUIREMENTS; FOR MONITORING THE MOL DEPARTMENT OPERATING BUDGET; FOR DEVELOPMENT AND INTERNAL AUDIT OF MANAGEMENT AND BUSINESS POLICIES, PRACTICES, AND PROCEDURES; FOR INTERNAL PROGRAM SURVEYS; FOR PAR AND GAR PREPARATION; AND FOR TECHNICAL PUBLICATIONS AND INFORMATION SERVICES; FOR INTEGRATING ATTENDANCE AT SYMPOSIA, DINNERS, ETC; FOR REPRESENTING THE MOL DEPARTMENT GENERAL MANAGER TO MD AND GE WITH RESPECT TO UTILIZATION OF SHARED RESOURCES; FOR INTEGRATING AND ISSUING COMPANY-REQUIRED REPORTS IN THE MARKETING CATEGORY.

PROGRAM MANAGEMENT  
SECTION

MANAGER  
DR. M. S. MALKIN

RESPONSIBLE FOR THE IMPLEMENTATION AND EXECUTION OF THE OVERALL MOL PROGRAM; FOR ESTABLISHING AND MAINTAINING TECHNICAL AND MANAGEMENT RELATIONSHIPS AND INTERFACES WITH CUSTOMERS AT THE PROGRAM DIRECTOR LEVEL, AND WITH ASSOCIATE PRIME CONTRACTORS AT THE PROJECT DIRECTOR LEVEL; FOR INTERPRETING PROGRAM REQUIREMENTS AND TASK DEFINITION AND FOR INTEGRATING AND DEFINING INTERNAL PROGRAM OBJECTIVES WHICH ENSURE MEETING THESE REQUIREMENTS; FOR ESTABLISHING AND IMPLEMENTING INTERNAL REQUIREMENTS, PLANS, SCHEDULES AND BUDGETS, AND FOR ASSIGNMENT OF THESE TO THE FUNCTIONAL SECTIONS; FOR RESOLVING ALL INTER-SECTION CONFLICTS AND INTERFACES; FOR MAINTAINING CONFIGURATION CONTROL; FOR MANAGING THE MAKE OR BUY PROGRAM; FOR MEASURING, EVALUATING AND REPORTING PROGRAM PROGRESS AND FOR TIMELY CORRECTIVE ACTION; FOR PARTICIPATION IN PAR PREPARATION; FOR SUPPORTING THE BUSINESS MANAGEMENT SECTION IN PROPOSAL AND CONTRACT NEGOTIATIONS WITH CUSTOMERS FOR IDENTIFICATION OF WORK-SHARE CHANGES AND SUPPORT IN NEGOTIATIONS, AND CONTRIBUTION TO LONG TERM PLANNING FUNCTIONS.

DEVELOPMENT  
SUBCONTRACTS  
SECTION

MANAGER  
R. G. MYERS

RESPONSIBLE FOR THE GENERAL MANAGEMENT OF SUBCONTRACTORS ON THE SUBCONTRACT ASSIGNED TO HIM BY PROGRAM MANAGEMENT; FOR SUBCONTRACT PROGRAM DEFINITION AND ESTABLISHMENT OF TECHNICAL, SCHEDULE, AND FUNDING REQUIREMENTS; FOR THE SELECTION OF SUITABLE SUBCONTRACTORS, SUBJECT TO REVIEW OF THE SOURCE SELECTION BOARD; FOR THE TECHNICAL AND BUSINESS CONTENT OF SUBCONTRACT AGREEMENTS; AND FOR SUBCONTRACTOR EFFORTS TO MEET MOL DEPARTMENT TECHNICAL PERFORMANCE, SCHEDULE AND COST REQUIREMENTS.

SAFETY AND RELIABILITY  
PROGRAMS SECTION

MANAGER  
G. HUGHEY

SYSTEMS ENGINEERING  
SECTION

MANAGER  
G. HALL

RESPONSIBLE FOR TECHNICAL INTEGRATION AT THE OVERALL SYSTEM LEVEL; FOR MISSION ANALYSES AND MISSION PROFILES; FOR OVERALL SYSTEM SPECIFICATIONS AND SYSTEM INTEGRATION; FOR GENERATION OF PERFORMANCE, DESIGN, AND EFFECTIVENESS REQUIREMENTS TO THE SUBSYSTEM LEVEL; FOR THE SYSTEMS SUPPORT OF SOFTWARE MISSION AND OPERATIONAL GROUND EQUIPMENT, POST INJECTION AND ORBITAL OPERATIONS, TRACKING, COMMUNICATION AND COMMAND STATIONS AND RECOVERY OPERATIONS; FOR GENERATION OF DESIGN REQUIREMENTS FOR THE INTERFACES WITH OTHER SYSTEM SEGMENTS; FOR NEGOTIATION OF THE EFFECTIVENESS APPORTIONMENT OF THE OVERALL SYSTEMS; FOR ANALYSIS AND INTERPRETATION OF IMPACT OF EXPERIMENT SUB SYSTEMS ON THE OVERALL SYSTEM; FOR MISSION SIMULATOR DESIGN, CREW INTEGRATION, AND OPERATION REQUIREMENTS; FOR ESTABLISHING REQUIREMENTS FOR SYSTEMS QUALIFICATION, ACCEPTANCE, LAUNCH SITE AND FLIGHT TESTS; FOR APPROVING SYSTEM AND SUBSYSTEM DESIGNS, SYSTEM TEST PLANS, PROCEDURES AND DATA, AND FOR RESOLVING CONFLICTS AMONG SUBSYSTEMS WHERE OVERALL SYSTEM PERFORMANCE IS AFFECTED; FOR ESTABLISHING BIOASTRONAUTICS AND HUMAN FACTORS CRITERIA AND CONSTRAINTS ON THE DESIGNS; FOR MANNED SPACECRAFT TECHNOLOGY AND ADVANCED SYSTEM ACTIVITIES.

DESIGN ENGINEERING  
SECTION

MANAGER  
C. F. HIX, JR.

RESPONSIBLE FOR DESIGN SPECIFICATIONS AND DRAWINGS, DEVELOPMENT TESTING, EVALUATION AND RELEASE OF CONTRACTED DESIGN HARDWARE ITEMS INCLUDING AVE SUBSYSTEMS AND COMPONENTS, AGE, SIMULATION AND TRAINING EQUIPMENT; FOR GENERATING INTERNAL ENVIRONMENTAL SPECIFICATIONS; FOR DETAIL DEFINITION OF EXTERNAL INTERFACES; FOR EXPERIMENT SUBSYSTEM INSTALLATION DESIGN, INTEGRATION AND EXCHANGE OF TECHNICAL INFORMATION AT MISSION MODULE LEVEL; FOR TECHNICAL SUPPORT OF PROCUREMENT, PRODUCTION, SUBCONTRACTS, TEST AND LAUNCH OPERATIONS, AND TECHNICAL CONTRIBUTIONS TO SYSTEM TRADE-OFF STUDIES; FOR COMPONENT AND SUBSYSTEM QUALIFICATIONS; FOR ACHIEVING DESIGN STANDARDS; FOR SUPPORT OF PROGRAM MANAGEMENT, BUSINESS MANAGEMENT, AND SYSTEMS ENGINEERING IN PROGRAM AND BUSINESS GROWTH ACTIVITIES.

BIOASTRONAUTICS  
SECTION

MANAGER  
R. W. LAWTON

RESPONSIBLE FOR THE HUMAN ENGINEERING AND BIOASTRONAUTICS INTEGRATION THROUGHOUT THE MOL BIOASTRONAUTICS COMMUNITY; FOR INTERFACE COORDINATION WITH USAF, TITAN III-C AND GEMINI-B HUMAN FACTORS (THROUGH THE PROGRAM MANAGEMENT SECTION); FOR HUMAN ENGINEERING CONSULTATION AND REVIEW IN THE AREAS OF IN-FLIGHT AND GROUND CREW FUNCTIONS AND PERSONNEL TRAINING REQUIREMENTS IN SUPPORT OF THE LABORATORY DESIGN, THE AVE, THE AGE AND EXPERIMENT INTEGRATION (THROUGH SYSTEMS ENGINEERING, SYSTEM TESTS AND DEPLOYMENT AND DESIGN ENGINEERING); FOR PROVIDING AND INTERPRETING CREW SUPPORT AND BIOASTRONAUTICS REQUIREMENTS; FOR THE SUPPORT OF ENGINEERING TEST AND EVALUATION OF THE MOL SUBSYSTEMS AND SYSTEM; FOR BIOSCIENCES AND HUMAN FACTORS SUPPORT TO DIVISION PROGRAMS.

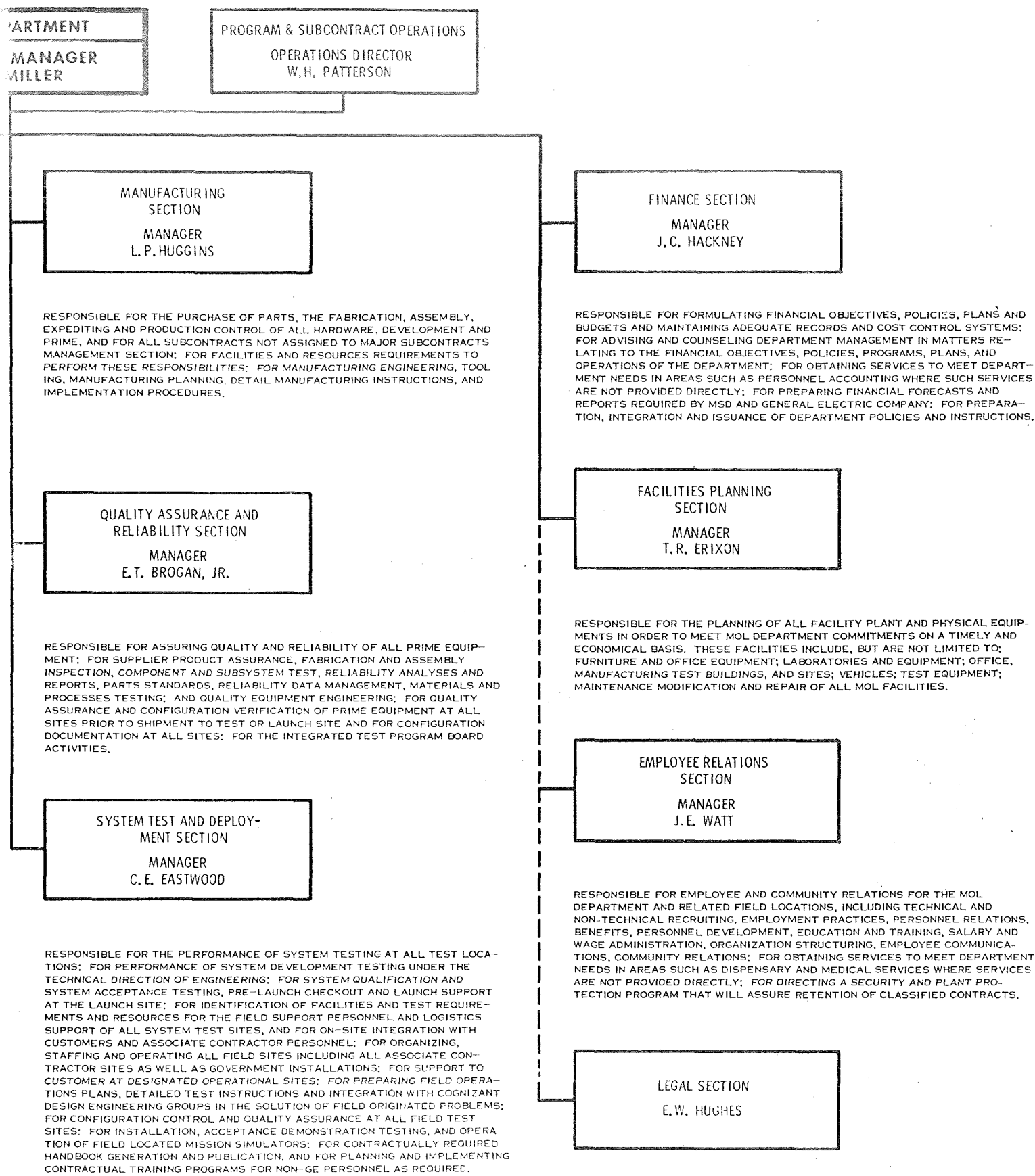


Figure 2-2. MOL Department Section Functional Chart

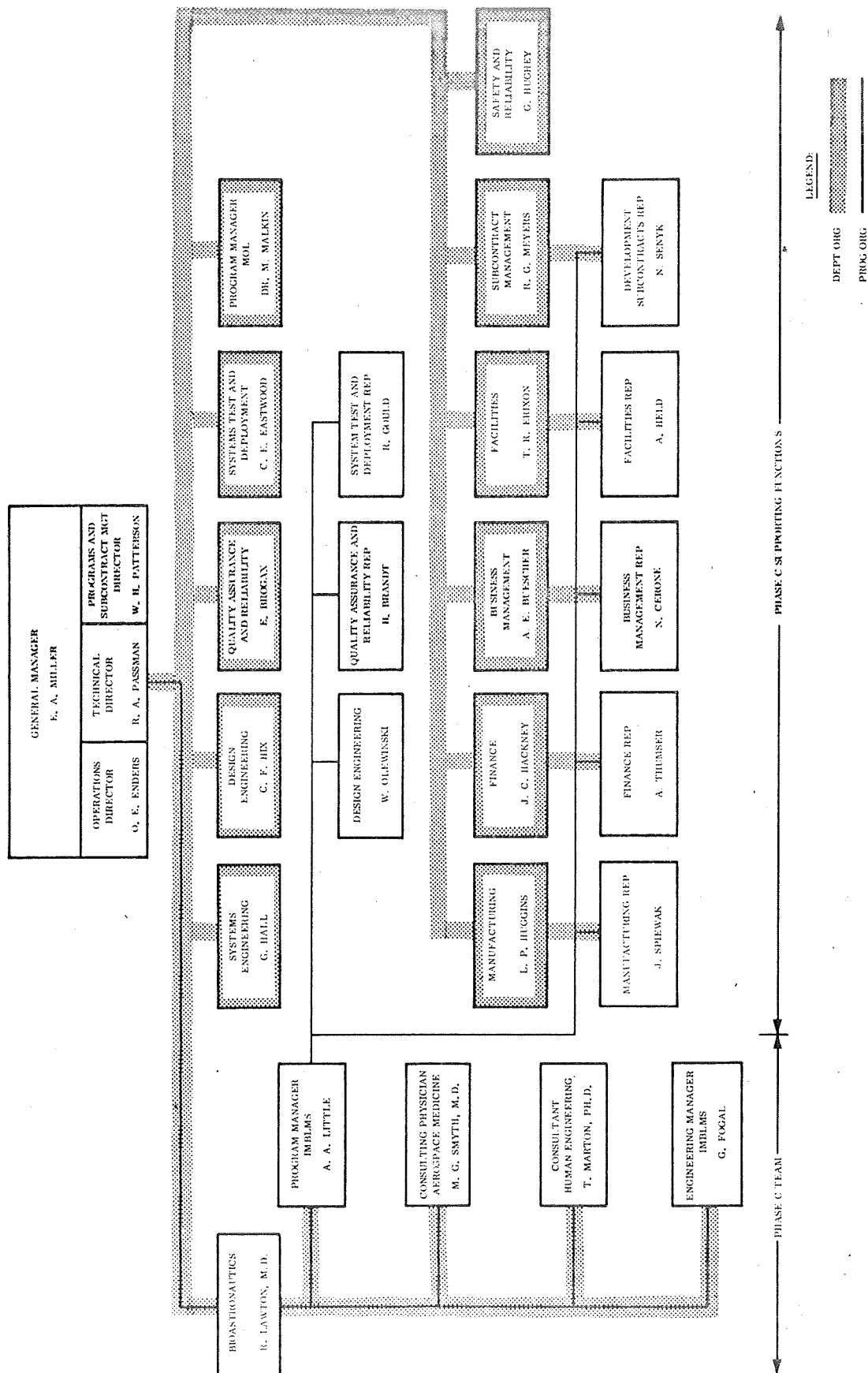


Figure 2-3. IMBLMS Phase C Organization

#### 2.2.1.4 Key Personnel

Resumes of key management and technical personnel are shown below. More detailed information on these personnel are shown in Section 5.3 of Vol. III.

<u>Name/Title</u>	<u>Education</u>	<u>Experience</u>
R.W. Lawton, Manager, Bioastronautics	M.D., Cornell Medical College 1944 B.A., Dartmouth College 1942	Presently Manager Bioastronautics Section of the Manned Orbital Laboratory Depart- ment. Served as Manager Life Support Systems for the Department/Division since 1959, supervising activities in bioscience, human factors, life support equipment and bioinstrumentation. Former head of Physiology Division of the Aviation Medical Acceleration Lab., NADC, Johnsville, and Associated Professor of University of Pennsylvania School of Medicine.
G.L. Fogal Manager, IMBLMS Engineering	M.S. Mechanical Engineering. University of Maryland, 1954. B.S. Mechanical Engineering, University of California, 1954	Presently Consulting Physician in Aero- space Medicine. In 1962 was Director of Research and Development at Smith, Kline Instrument Co., responsible for the development of new medical instrumenta- tion devices. Formerly was Clinical Research Director at Smith, Kline and French Laboratories.
T. Marton	Ph.D. from Princeton in 1962. Certificate on Prosthetics from UCLA in 1953. Received MS in 1951 and BS in 1949 from New York University.	Presently, Consultant, Human Engineering. Has included work in such areas as; manned tests for OSS and MOL operations, human-factor design and performance reliability during the Apollo mission, mobility evaluations via pressurized space suits, and prolonged weightlessness. Research at Princeton covered various emotional and physical aspects of psychol- ogical and physiological human behaviors.

<u>Name/Title</u>	<u>Education</u>	<u>Experience</u>
A. A. Little	MBA Industrial Engineering, Temple University, 1957. MS Mechanical Engineering, University of Pennsylvania, 1950. BS in Aero Engineering MIT, 1946	Currently Manager IMBLMS Program; responsible for planning, control and integration of the IMBLMS effort. 1966-1967 Manager of Integration and Evaluation Engineering in MOL Department. Prior to this headed the proposal effort for GE-MOL's experiment integration role in the engineering development phase and served on the contract negotiation team with responsibility for flight equipment.
M. F. Clarke	BA Physics, University of Oklahoma, 1946	Presently responsible for Advanced Maned Systems Design Engineering. Previously directed engineering effort on Biosatellite proposal and study, Satellite proposal and study, Satellite Re-entry and Recovery Vehicles, and a classified satellite program. Directed a Life Support Engineering Group to design the Life Support Subsystem for the NASA Biosatellite Program. Organized the first satellite recovery vehicle Discoverer Program.
F.W. Thomae, Jr.	MA University of Texas, 1954. AB from Brown University in 1950	Presently responsible for studies on sampling, analysis, and preservation of biological materials during space flight. Formerly Research Scientist at Radiobiological Laboratory of University of Texas, working on modifications of clinical methods for use on small animals, hematological studies, and enzyme assays. Participated in a variety of programs in Life Sciences Section of LTV Astronautics Division.
M. G. Bengson	MS University of Iowa, 1949. BS Physics and Chemistry, Monmouth College 1947	Presently with Bioscience and Human Factors Operation. Activities include consultation on Biosatellite program, spacecraft toxicology, and microbiology. Prior to this was Manager of Titan II explosives integration program. Formerly Technical Operations Officer at Sandia Base, New Mexico.

<u>Name/Title</u>	<u>Education</u>	<u>Experience</u>
B. J. Mirowsky	BSEE University of Missouri, 1951.	Currently responsible for design leadership in electrical, power and electronic systems for advanced manned spacecraft applications. Designed the recovery electrical and electronic subsystems for the first successful satellite re-entry vehicle on Discoverer Program. Previously worked in conjunction with NASA, MSC, and KSC personnel in the system development of the digital Automatic Checkout Equipment.
R. W. Richardson	MBA candidate at Drexel Institute of Technology. BSCE Drexel Institute of Technology, 1958	Presently Configuration Design Engineer for Advanced Manned Systems Engineering Projects responsible for configuration design requirements and supporting documents for advanced spacecraft configurations. Previously Senior Structure Engineer on Apollo Project for North American Aviation Company, responsible for the analytical verification of vehicle structural integrity.
P. J. Caliando	MS Electrical Engineering, University of Florida 1965. BS Electrical Engineering, Pratt Institute, 1957.	Presently Subsystems Engineer, Data Management. Was Systems Engineer with Apollo Support Department engaged in specification of computer interface requirements used for checkout of Apollo Spacecraft and Lunar Excursion Module. Formerly with Airborne Instruments Laboratory responsible for study, design, and test of special digital data handling equipment.

### 2.3.2 ASSOCIATES, CUSTOMERS AND INTERFACE CONTROL

Design and control in the areas of the Spacecraft and IMBLMS interfaces must be carried-out by a means that will ensure proper and timely design integration.

The overall IMBLMS assembly will be designed in modular segments which can be adapted to the three specified spacecraft with a minimum of modification or requalification required: (1) the Orbital Workshop (OWS), (2) the Lunar Landing Module (LM), (3) the Refurbished Command Module (RCM). The modular segments will be designed to interface with the three spacecraft with respect to weight, shape/volume, electrical power requirements, and auxiliary services for liquids, gases, coolants, data transmission and command and control.

A Schedule Interface Log (SIL), similar to that employed on the MOL Program, will be used for the IMBLMS Program. This log is a listing of interface between the IMBLMS Program and AAP participants. All interface events required for the various aspects of the design, and later for the development, are recorded as soon as the need is identified. The requestor, description of the interface, need date, source of the event, promise date, action taken or needed and person responsible are all logged. Receipts are channeled through the log and to the requestors. Operation and integration of the Schedule Interface Log will be the responsibility of the Program Manager. Defining and documenting all significant interfaces and the conduct of regular reviews of these ensures design integration and permits program management to keep delays to a minimum.

Interface specifications will be prepared as applicable. These specifications will record design agreements which provide the means to define, evaluate, and control all mutually interdependent design parameters and to assure the physical, functional, and operational compatibility of the system, its control end items, and other elements making up the system. These specifications will be prepared in conformance with M200B, Chapter V, of the Defense Standardization Manual.

General Electric will be responsible for assuring that functional and physical interfaces between equipments within its design cognizance and equipments under the cognizance of other contractors are documented in formally issued and controlled interface specifications. Relationships between NASA procured specialized equipments and IMBLMS will be a part of such interface specifications.

In Phase C, design layouts will be provided to show how the total IMBLMS modular segments, or portions of the total, could be installed in the three spacecraft. Interface diagrams, drawings, and specifications will be provided to establish interface requirements and preliminary designs for installation and interconnection of the IMBLMS equipment with the three spacecraft. The primary interfaces will include the mechanical installation and mounting designs, the electrical power interfaces, the command and control interfaces, the electrical and electronic interfaces for communications, telemetry, data handling, monitors and displays, and the support services interfaces. The support services interfaces will include water, gases, vacuum, coolants, waste disposal, etc.

The interfaces with the different spacecraft will be designed to provide a maximum of commonality in usage of connectors and mounting hardware. The designs will include provisions to assure crew access for maintenance and repair and human engineering considerations with respect to actual astronaut hookup of the measurements/spacecraft interfaces.

Crew safety provisions will be included in the interface designs. Material selection and usage for the designs will be compatible with the existing requirements for the three spacecraft on which the IMBLMS equipment will be used. The interfaces of the IMBLMS equipment with the spacecraft electrical, mechanical, and thermal systems will be designed to assure that the installation of this equipment will not jeopardize the crew safety or mission success probability of the manned spacecraft.

### 2.3.3 SUBCONTRACTORS

The General Electric Company MOL Department is committed to assemble the strongest possible technical team available to execute the IMBLMS Program. In addition to GE personnel, this team contains selected individuals and companies from the medical and aerospace industries. Pursuant to the philosophy of maintaining the capability openly to select the strongest support available, General Electric has not at this time any firm plans to use funded subcontracts in Phase C (other than use of consultants). In general, it is planned to obtain the best subcontractor expertise in specific areas; General Electric may provide assistance and guidance in orienting subcontractors to the methods and demands of the space business. A number of potential key supporting personnel and organizations have been contacted and surveyed and have expressed willingness to work with General Electric on the IMBLMS Phase C Program. If it becomes appropriate during Phase C to enter into any funded subcontracts, it will be done in accordance with established procedures, through reprogramming of available funds and with cognizant contract monitor approval.

The tasks that these persons and companies may be asked to perform in their particular offerings in Phase C will, in general, be as follows:

- a. Perform preliminary design on equipment selected for IMBLMS and provide specifications and parameters (weight, volume, power, interfaces) of this equipment for GE use in performing system design, packaging, and other technical tasks.
- b. Perform preliminary design, layouts, schematics, and estimates of the critical parameters for the equipment now only in conceptual or breadboard form, but selected for IMBLMS.
- c. Provide performance parameters and safety, reliability, and interface requirements where General Electric needs supplier information to prepare procurement specifications.

To provide continued emphasis on surfacing the best subcontractor support for Phase D, an experienced Subcontractors Manager has been assigned full time to the IMBLMS Program Manager.

## 2.4 MANAGEMENT AND CONTROL FUNCTIONS

### 2.4.1 WORK BREAKDOWN STRUCTURE AND TASK DEFINITIONS

The Work Breakdown Structure (WBS) is based upon the nature and outputs of the program and the organization of the work. It is designed to provide complete coverage of all relevant items, plans, schedules and costs; and is mutually exclusive in the definition of the work elements.

The WBS for the Phase C-Design shown in Figure 2-4, is expandable and adaptable to the succeeding Phase D work.

The WBS is defined to Level 3. There are four Level 1 Subdivisions of Work (SOW) which are identified as:

- Program Management
- Systems Engineering
- Design Engineering
- Phase C Support and Phase D Proposal Support

Each of these subdivisions is further divided into two or more Summary Tasks and each of these into two or more Work Package Tasks. Each task has been defined with regard to:

- Task description
- Responsible individual
- Schedule dates
- Products
- Manpower

It is the monitoring and analysis of the basic elements of the Work Package Tasks which will provide program control.

Further definition of the content of each of the Subdivisions of Work is given in the "Management Control Plan", Section 4 of this Volume.

### 2.4.2 FUNDING, COST AND SCHEDULE CONTROL

The funding of work package tasks is to be handled through the presently operative system of Program Funding Instructions (PFI). This system permits the Program Manager to control the allocation of funds to the performing organization. Weekly reports of expenditures against the PFI's are compared to budgets and appropriate management control is exercised in the event of any deviations.

The use of milestone reporting in the form of the Integrated Milestone Reporting System (IMRS) is utilized as the schedule control.

Further discussion of these existing cost and schedule techniques are set forth in Sections 3 and 4 of this volume.



### 2.4.3 TECHNICAL DIRECTION

The internal technical direction of the program activity is initiated by the task definitions, as agreed to between the Program Manager and the performing Organizations, in the PFI's. Continuing technical direction is exerted by the Program Manager, both in and following the Weekly Program Meetings. These meetings between all principal managers and contributors assigned to the program provide vital communications and opportunities for problem identification and solution.

Day-to-day contact between the Program Manager and key contributors will of course provide significant continuing direction.

Customer technical direction of the program will initiate from the Phase C Contract Work Statement plus revisions scheduled to the measurement requirements. Informal contacts by technical specialists with appropriate counterparts in the NASA organization will aid the contractor in his interpretation of requirements and in being responsible to the needs of the customer. The oral mid-term review will provide an important check-point in the course of the program. The official customer direction channel is described in 2.2.2.2.4.

### 2.4.4 DOCUMENTATION

The documentation plan is responsive to the objectives and requirements of document management pertinent to a program of the size and scope of the IMBLMS Phase C contract and of sufficient depth to form the basis of a document management plan for IMBLMS Phase D. The key features of the plan are:

- Document management is established as a management support operation. The generation, preparation, production and reproduction of documents remain the responsibility of the appropriate line operations.
- Document Management encompasses not only the acquisition and management of documents across contractual interface but also the management of in-house documents.
- Requirements for documents are established by the users thereof and are validated on the basis that the documents identified are essential to the effective accomplishment of an authorized work package.
- Existing facilities and operating procedures are used to the maximum extent.

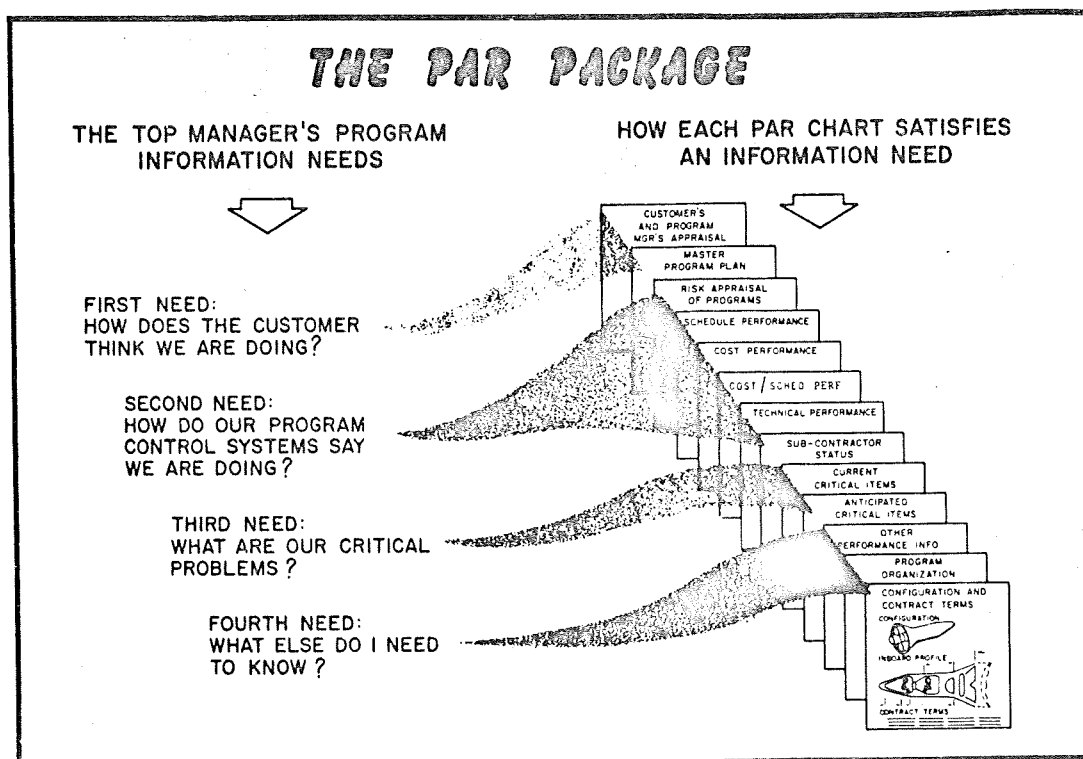
Further definition of the documentation requirements and plans are given in Section 5 of this volume.

### 2.4.5 MANAGEMENT REPORTING

Top management will be regularly informed on the conduct of the IMBLMS program by use of the Program Appraisal and Review (PAR) System. During the Phase C portion of the program

PAR reports will be scheduled with the MOL Department General Manager. In the succeeding phase PAR presentations will be made to the Division General Manager.

PAR, a program information reporting system, is tailored to meet the specific needs of top management. The system was developed early in 1962 at the Missile and Space Division, where it has since been in constant use with periodic updating to reflect current management status. It is a simple, low-cost method of providing the top manager with information on the significant programs within his responsibility. The PAR system utilizes a structured format whereby the myriad of existing program data are filtered to give the top manager specific program information so as to satisfy his needs in a uniform manner across all programs. The four basic needs of the top manager which are satisfied by the structured PAR format are shown in the figure below. Informal, oral presentations are made monthly on each major program by the Program Manager, permitting in-depth questions on selected areas. The top manager utilizes the information from the system for personal Customer interactions, corporate communications, and for implementing and integrating actions.



## 2.5 DESIGN APPROACH

### 2.5.1 TECHNICAL REQUIREMENTS AND SOLUTIONS

The complete IMBLMS is intended as a service and measurement capability supporting any of the currently-identified experiments but sufficiently broad in scope so as to accommodate measurements for as-yet-undefined future experimental procedures. The selection of experiments for any particular mission will be determined by several variables, such as priority of experiment, time available, characteristics and identity of the measurement site, which will influence the programming and grouping of experiments. The General Electric approach to accommodating such diverse experimental measurement requirements is to define a basic measurement capability which would be essential in any experiment combination. Modules of IMBLMS are added as required for the particular, selected group of experiments.

Each experimenter will want to measure the general environment in which his experiment is being performed. Acquisition of atmospheric parameters of temperature, total pressure, gross composition (i.e. oxygen, carbon dioxide, diluents, water vapor partial pressure) plus, perhaps, the "g" level are desirable. Other environmental factors such as light level, trace contaminant concentration, may be required. None of the presently-identified experiment performance areas (LM, MDA, CM, S-IVB) provide a complete readout of the environment. In the LM system, although oxygen concentration is available, neither water vapor concentration nor "g" level is available, and the accuracy of the data that is available may not be compatible with the experiments' needs. As shown in Figure 2-5, a feasible basic

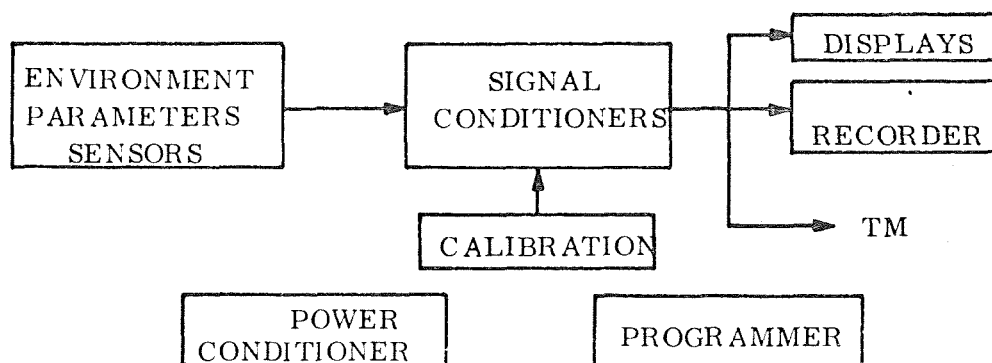


Figure 2-5. Basic Measurement Capability (Environment Parameters)

measurement capability would comprise the modules for environment sensing, power conditioning, signal conditioning, and the data-management complex to provide the necessary measurement of the experimental environment.

Because IMBLMS hardware is multiple-purpose wherever possible and thus capable of supporting more than one sensor, both single-purpose and potential multiple-purpose modules can be identified.

The performance capability of each module must be based on the requirements of the entire IMBLMS assembly. One approach is to make each multi-purpose module capable of supporting all foreseeable measurements. In some instances, this may be desirable. In others, the resulting physical size and weight or other complexity may warrant two or more submodules having the same system function, either identical in capability, or each having a different range of capability. For example, the power conditioning function for the total IMBLMS could be provided by three identical (or similar) power conditioning submodules. If only a few measurements are required for a specific mission, only one of the power conditioning submodules would be used.

Whether a specific system function should be provided by several identical modules or one single module will depend primarily on the range of performance required and the effect of this performance range on physical size and weight. If the performance range is narrow

or can be accommodated without significant effect on the size and weight, only a single module per function should be used.

Inherent in the General Electric IMBLM system concept is the definition of a module as a system element which performs a specific system function. Dividing the IMBLMS into "standard" functional modules offers flexibility in meeting specific mission experiment requirements. Only those modules which are required are used, thus reducing size, weight, and cost for that particular mission.

This flexibility of accommodating multiple spacecraft/experiment conditions requires a compatible packaging concept. If each module (or submodule) has an integral support structure, excessive weight of an overall IMBLMS can result. Thus, a support structure which contains all the necessary modules for a specific mission is desired. This overall support container for a specific mission must therefore physically accommodate all of the functional modules with interconnections (electrical, pneumatic, etc.) internal to the IMBLMS assembly. The structural container is thus a unique design for each specific mission. This approach, in addition to minimizing size and weight, permits the shape of the support container to conform to the space available in the spacecraft, a significant advantage for restricted volume spacecraft such as LM and CM. Maximum size, however, will be limited by airlock dimensions and crew handling capability. A maximum size IMBLMS assembly may consist of three substructures (or modular segments) as noted in General Electric's Phase B technical report.

In summary, the General Electric approach to the IMBLMS system concept is to define a minimum (i.e. basic) measurement capability. This basic capability provides measurements of those experiment parameters (i.e., heart rate or status of the environment) which are potentially needed for every medical and behavioral experiment. Additional functional modules are added to this basic capability to meet the total experiment measurement and support requirements as defined for a particular mission.

## 2.5.2 ENGINEERING PROCESS

A series of controlled, formally released documents constituting the "Requirements Documentation Package" will be assembled through the course of the Phase C Program. Each of these items is summarily described below. These products of the Engineering process are closely integrated with the Test, Reliability and Quality Assurance activities described in greater detail in other sections of this plan and in this volume.

### 2.5.2.1 Preliminary System Requirements Document

The system performance and design requirements based on the results of the Phase B studies and System Engineering activities conducted during Phase C will be defined in this specification, prepared in conformance with the requirements for a "Master End Item Specification" as defined in the MSC Supplement #1, Rev. B, dated 26 April 1965, to NPC 500-1, dated 18 May 1964, Apollo Configuration Management Manual.

#### 2.5.2.2 Preliminary CEI Specifications

Preliminary specifications will be prepared in accordance with the Part I portions of the applicable Exhibits (II, IV, V, VI) of NPC 500-1. The performance and design requirements stated therein will be based on and compatible with the performance and design requirements given in the system requirements specification and the functional allocations resulting from System Engineering activities and packaging analysis.

CEI Specifications foreseen at this time include those for:

- a. IMBLMS Flight Equipment Total Package (may be more than one set to cover configuration differences between missions.)
- b. Operational Support Equipment
  - 1. Electrical OSE
  - 2. Mechanical OSE
  - 3. Trainer
  - 4. Computer Software
- c. Maintenance Ground Equipment
- d. On-board Maintenance Equipment
- e. Deliverable Functional Prototype
- f. Deliverable Mockup

#### 2.5.2.3 Preliminary Test Requirements (Development and Qualification)

The preliminary requirements for development test, qualification test, reliability test and analysis, and their relationships embracing integrated test requirements for component, system and subsystem will be developed during Phase C.

#### 2.5.2.4 Preliminary Environmental Specifications

Preliminary environmental specifications will be prepared to define the expected environments and the levels to which components shall be tested for both qualification and acceptance.

#### 2.5.2.5 Interface Specifications

Interface specifications will be prepared as applicable. These specifications will record design agreements which provide the means to define, evaluate, and control all mutually interdependent design parameters and to assure the physical, functional and operational compatibility of the system, its contract end items, and other elements making up the system.

#### 2.5.2.6 Preliminary Block Diagrams, Preliminary Analysis and Inboard Profiles

These are products of the GE-MOL Department in-place "Stage Release System", as discussed in Section 3 of this Volume. This system provides for formal scheduled release of engineering information meeting pre-planned contents and design tolerances in four successive stages of refinement. By direct application of this stage release system, the requirements in the areas of equipment and subsystem block diagrams, preliminary analyses (i.e. thermal, dynamic, controls, weight and balance, stress, size, power), and inboard profiles will be released as part of the initial or Stage I subsystem release. During Phase C, the design will be released, meeting Stage I release requirements. The pre-Stage I release design review will be carried out as part of the Concept Design Review with the customer.

#### 2.5.2.7 Selected Parts/Materials and Processes Lists

A preliminary Selected Parts List based on program requirements will be developed and used. This list will contain electronic and electromechanical parts and part derating and application requirements. High reliability parts, with the addition of screening and burn-in where applicable, will be used for flight equipment.

Selected Materials and Selected Processes lists will be developed of materials suitable for use on IMBLMS in the spacecraft to be utilized, drawing on both the COMAT data bank and MOL experience.

#### 2.5.2.8 Procurement Specifications for Buy Items

As an integral part of the make-or-buy effort, sufficient data will be released to permit intelligent make/buy decisions and intelligent quotations for buy items. Because of the short duration of Phase C and the number of modules (i.e. components) to be designed, preliminary module specifications will in general consist of the requirements applicable to all items, plus a summary sheet of the requirements of the item involved.

#### 2.5.2.9 Required Drawings

GE-MOL Department has in place a drafting system which meets the requirements of MIL-D-1000 Form 2 drawings. During Phase C, all drawings called for in consonance with the GE Stage I Stage Release requirements will be released meeting these standards and satisfying the content requirements of Category A "Design Evaluation", Category B "Interface Control", or Category F "Procurement" (interchangeable items).

#### 2.5.2.10 Preliminary Test Specifications

Preliminary test specifications will be developed during Phase C for each equipment identified as a CEI or Engineering Critical Component, as based on the Preliminary Test Requirements. They will be incorporated directly or by reference in the applicable CEI and component specifications.

## 2.6 TEST PROGRAM PLANS

The presently defined Phase C program may have a small amount of exploratory testing (not presently planned). However, the principal test program effort in Phase C will be the development of an Integrated Test Plan for use in Phase D. The objective will be to plan a test program which provides maximum flight confidence at minimum cost.

Key features of the test plan:

- Test planning is established as a program-wide effort, led and integrated by experienced test planning personnel.
- Test planning is programmed during Phase C to proceed with the preliminary design process.
- The resulting test plan will cover:
  - All categories of testing (development, qualification, verification, acceptance)
  - All levels of testing (component through system)
  - Objectives, relationships, environmental levels, reporting requirements of all tests

The test planning steps will be

- Initial Scoping/Preliminary Development Test Outline
- Update Development Plan/Scope Qualification Plan
- Initial Test Plan Drafted
- Update Documents/Planning Analyses

An Integrated Test Plan will be evolved which will include the following:

- a. Test "Matrix" (Tests matched to requirements to be verified)
- b. Development Tests
- c. Qualification Tests
- d. Validation Tests
- e. Acceptance Tests

Further details regarding this plan contained in "Plan for Integrated Test Plan", Section 7 of this volume.

## 2.7 MANUFACTURING PLANS

### 2.7.1 PHASE C ACTIVITIES

During Phase C, manufacturing activities will include:

- Support and influence the design from a producibility standpoint.
- Participate in vendor surveys; contribute to the make/buy process and prepare for Phase C purchases.
- Perform preliminary manufacturing planning and contribute to facilities planning.

### 2.7.2 MAKE OR BUY PLAN

During Phase C, make or buy decisions will be accomplished in accordance with the Make or Buy Plan and MOL Department policy. Make/Buy decisions will be made by a Make/Buy Board and source selection decisions by a Source Selection Board, both having representation from affected sections and both chaired by the Program Manager. The make or buy process includes determination of proper work packages for Make or Buy consideration, vendor and industry surveys and the make or buy decision using the best source irrespective (without abrogating General Electric's responsibility for System performance) based on the following criteria:

- a. Customer Requirements

- b. General Electric Capability and Capacity
- c. Industry (Vendor and/or Subcontractor) Capability and Capacity.
- d. Relative Cost and Schedules
- e. Design Status and Interface Definitions Status
- f. Product Quality
- g. Small Business Participation and Labor Surplus Areas

The Source Selection process includes RFP's to qualified bidders, evaluation of technical, management and cost aspects of proposals by appropriate disciplines, recommendation to and source selection by the Source Selection Board, and fact-finding and negotiation. The results of Phase C make or buy and Source Selection activity will become part of the Phase D Make-or-Buy Plan.

### 2.7.3 MANUFACTURING PLAN

During Phase C, manufacturing will perform and document in a Phase D Manufacturing Plan the planning to define the operating methods to be used in Phase D for procurement, fabrication and assembly of hardware to meet the quality and reliability requirements while fulfilling the schedule needs. It will also define the organizational structure, their functions and responsibilities, tasks and subtasks. The plan will include an integrated hardware flow, schedule sequence of manufacturing operations (including process specifications to be used), methods, tooling to be utilized, proposed facilities, special tooling, equipment handling procedures, and manpower needs.

### 2.7.4 FACILITIES PLAN

The Phase D facilities plan prepared in Phase C will contain an integrated description of all General Electric and possible Government owned facilities to be used in Phase D for the development and production of software and hardware for IMBLMS. Facilities include all laboratories and inspection and test facilities, production facilities, and support facilities. The plan will describe how the facilities will be used and predicted loadings.

## 2.8 RELIABILITY AND QUALITY ASSURANCE PLANS

### 2.8.1 RELIABILITY PLAN

The reliability requirements of NPC 250-1 will be implemented during Phase C of the IMBLMS program by a reliability team consisting of members of the Departments' IMBLMS Engineering, Design Reliability Engineering and OA&R Reliability and Safety Engineering.

The Reliability Plan for Phase C includes establishment of reliability goals and apportionment, prediction of reliability versus goals, Failure Mode, Effects and Criticality Analysis and completion of design trade studies.

Further definition of the Reliability Plan for Phase C is documented in Section 8 of this volume.

### 2.8.2 QUALITY ASSURANCE PLAN

The Quality Assurance and Reliability Section of the MOL Department will follow a quality program in accordance with NAC 200-2 during Phase C of the IMBLMS program.

The IMBLMS equipment design will be documented during Phase C by Stage I Engineering Documentation and Part I CEI Specifications. This design will be reviewed by Quality Control Engineering to assure that all aspects of quality, such as producibility and testability, are designed into the equipment.

Materials and Processes Engineering will develop lists of selected materials and processes that are acceptable for AAP equipments and review the IMBLMS design to assure proper selection and application of all materials and processes.

Contributions to test programs for development and qualification testing will be made by QA&R. The total plans will also be reviewed by QA&R.

Quality Assurance and Reliability Provisions documents will be prepared for all IMBLMS equipment determined to be critical buy items.

Further definition of the quality program planned for Phase C is documented in Section 9 of this volume.

## 2.9 SYSTEM SAFETY ENGINEERING PLAN

### 2.9.1 INTRODUCTION

The preliminary system safety engineering plan is herein defined. This outline presents the proposed organization and activities which will comprise the plan. The approach defined is in accordance with MIL-S-38130A.

### 2.9.2 SYSTEM SAFETY ENGINEERING RESPONSIBILITIES

A System Safety Engineer reporting on assignment from the Reliability and Design Safety Operation to the Program Manager will exercise primary cognizance over program safety activities and will be responsible for the conduct, administration and control of the safety program. The authority and responsibility of the engineer to monitor the functional groups to insure compliance with safety regulations will be defined. In situations where controversy arises and cannot be resolved on a direct operating basis, a direct channel of the IMBLMS Program Manager will be used.

The Safety Engineer will be the coordinating agent for all safety matters affecting the program at GE, subcontractor facilities, other interfacing organizations, and with NASA.

### 2.9.3 SYSTEM SAFETY REQUIREMENTS

The board-spectrum safety program to be conducted on the IMBLMS Program will incorporate protective measures as follows:

- a. For astronauts and all other persons working with the equipment - from spacecraft equipment design and hazardous operating procedures
- b. For spacecraft hardware and equipment - from itself or interfacing equipment in the event of failure
- c. For spacecraft hardware and equipment - from people.

### 2.9.4 MODULE ANALYSIS AND POST-ANALYSIS ACTION

Hazards and their degree of criticality are identified for each IMBLMS module by considering the module itself, the interfacing of modules, and the interaction with the astronauts, spacecraft, support equipment and facilities. The design engineer shall be responsible for the hazards identification and classification coordinated by the systems safety engineer. Preliminary system safety hazards will be identified in the Phase C design process.

As a result of the analysis the following action will be taken in descending order of preference to minimize hazards:

- a. Design for minimum hazard - To obtain a high degree of inherent safety through the selection of appropriate design features, proven components and operating principles
- b. Employment of safety devices - Where hazards cannot be eliminated, reduction of risks by incorporation of safety devices.
- c. Incorporating warning devices - Where hazards still exist, use of warning devices
- d. Devising special procedures - Where the nature of the hazard is such that use of the above fails to reduce the risk adequately, use of special operating procedures minimize the possibility of a hazardous event.

### 2.9.5 HAZARD CLASSIFICATION

Utilizing failure modes and effects analysis a classification will be made of all identified hazards. They will be classified as follows:

- I. Safe - No system or personnel damage
- II. Marginal - Degrades without major damage
- III. Substantial system/personnel damage
- IV. Catastrophic - Loss of mission or loss of life.

NASA will be advised of design and procedures aspects which have been classified as critical or catastrophic, and specific corrective action will be defined. Class IV, catastrophic Items, and Class III, Critical Hazards, will be eliminated or minimized consistent with program objectives.

#### 2.9.6 SYSTEM SAFETY ANALYSIS AND POST-ANALYSIS ACTION

The first goal of the safety engineer is to ensure that safety is designed into the spacecraft and associated equipment. Design criteria based on identification of safety hazards will be utilized to accomplish this. Tradeoffs will be made in hardware design which will result in an acceptable balance between reliable performance and a sometimes unavoidable degree of safety risk. Through the use of a number of accepted and proven analytical techniques, the subsystems will be analyzed to determine the effect of failure or premature operation on the safety of the system. The System Safety Engineer will participate in all Design Reviews and review and approve all specifications and design releases.

As deficiencies or potential hazards become apparent through analysis, discussions will be held with the appropriate design engineer to effect the necessary changes. Where safety features would involve or affect other equipment and/or operations, the problem will be resolved by a board consisting of a representative of each major function involved, and chaired by the Systems Safety Engineer. Recommendations of the board will take into account the operational requirements and the tradeoffs of weight, size, cost and schedule. Resultant changes in design to reduce or eliminate the hazard will be fully coordinated with the design engineers who will be responsible for having these changes made to the appropriate drawing and specification.

## 2.10 LOGISTICS SUPPORT PLANS

Logistics support plans to be developed during Phase C for implementation in Phase D will be based on the hardware design developed during Phase C, the results of maintainability analysis, and the spare parts provisioning requirements. Support equipment development and training plans will also be generated. These plans will include the organization structure, responsibilities, and relationships for establishing provisioning, site, and on-board inventory, and transportation and storage and constraints.

### 2.10.1 MAINTAINABILITY PROGRAM

During Phase C, General Electric will implement a maintainability program consisting of three key efforts:

- a. The generation of a formal maintenance concept defining the accomplishment of preventive and corrective maintenance during the ground flow cycle from fabrication through launch and during orbit, so that the hardware design will evolve in support of the maintenance concept. Maintenance policies will be integrated with AAP operational and support concepts and requirements. Policies relating to launch site maintenance provisions, manual versus automated checkout and fault isolation techniques, and the allocation of orbital time to maintenance operations will require special attention.
- b. The development of design requirements for maintaining the system elements at an acceptable level of overall effectiveness by the evaluation of the gross system maintenance concept in relation to hardware specification requirements. Particular emphasis will be placed on:
  1. Accessibility
  2. Ease of replacement
  3. Interchangeability
  4. Operational status verification
- c. The development of a Maintainability Plan for use during Phase D. The plan will contain a description of the tasks and activities to be performed and the methods to be used to achieve optimum on-orbit and prelaunch maintainability and the management organization responsible for control and implementation.

The maintainability program will aim at avoiding costly maintenance during prelaunch operations and/or costly redesign in the program. Effective data return from the IMBLMS can only be assured if provisions are made early for flight crew response to on-board contingencies through a maintainability program.

## 2.10.2 SUPPORT EQUIPMENT DEVELOPMENT PLAN

This plan will consist of three sections, the first concerning Operating Ground Equipment, the second concerning Maintenance Ground Equipment, and the third concerning onboard maintenance equipment. The plan will establish responsibilities and time phasing for detailed analysis of needs and for start and completion of design and development, as related to the flight equipments. The plan will be used as a base for conducting systematic review and analysis of needs for support equipment. It will also serve as a source of information affecting system or end-item design in that an analysis of functions requiring support, coupled with maximum utilization of existing flight items and optimum maintainability, will result in tradeoffs between end items and support equipment design.

## 2.10.3 TRAINING PLAN

During Phase C of the IMBLMS Program, a training plan will be prepared. This will require performance of a Personnel Training Requirements Analysis (PTRA) to identify the type and scope of training to be recommended for operation and maintenance. Additionally, this training plan will require identification and depth of coverage required for course charts, lesson plans, manuals, and visual aids, to support an adequate curriculum. This plan will cover both ground and flight personnel training. A significant feature of the Phase D effort will be the development of an experiment timeline analysis and a development test program using functional engineering prototype hardware. This exercise will afford the opportunity to realistically appraise the Phase C training plan for revision in Phase D.

## 2.11 PHASING AND SCHEDULES

### 2.11.1 MASTER PHASING SCHEDULE

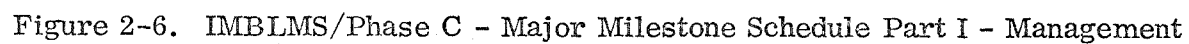
The phasing of the Phase C IMBLMS Program is shown in Figures 2-6 and 2-7, Major Milestone Schedule - Part I, Management and Part II Technical. These are based on GE Fiscal Weeks starting with Week 44(ends Sunday 5 November 1967).

The scheduled go-ahead is Fiscal Week 44 followed in 2 weeks (Fiscal Week 46) by an updating of NASA inputs of Revised Measurement Requirements. The contractor's identification of measurements that constitute the basis for design will then be established by FW 50. This is predicated on the NASA inputs not causing a major change in measurement requirements.

Monthly Progress Reports will be submitted to NASA throughout the Design Phase. An oral mid-term review which in effect is a Conceptual Design Review is scheduled in FW 5.

The contractor's Phase D program recommendations will be submitted in FW 9. The receipt of the RFP for Phase D is anticipated FW 14, which will be followed by delivery of the contractor's Summary Report and Phase D proposal in FW 18. This will constitute the end of Part I of Phase C.

The succeeding 2 months of effort will be directed toward updating and revising the Summary Report culminating in submittal of the Final Summary Report the end of FW 26.



- 1 BASED ON PHASE B  
 2 NASA REVISED INPUTS  
 3 BASED ON NASA INPUTS
- U UPDATE DURING PHASE C  
 F FINAL FOR PHASE C

	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
SYSTEMS ENGINEERING	45	46	47	48	49	50	51	52				
SYSTEM REQUIREMENTS:												
IDENTIFY MEASUREMENT	Δ	Δ										
DEFINE RQMTS.												
MEASUREMENT EQUIPT.		Δ		Δ								
(MEDICAL BEHAVIORAL)												
INTERFACES	Δ	Δ		Δ								
SPDR												
SYS DSGN/DEFINITION												
PRELIM. ENV. SPEC.		Δ		Δ								
PRELIM. I/F SPEC.												
PRELIM. SYS. DSGM.												
CEI SPEC (MASTER)												
BLK. DIAG/SCHEMATIC	Δ		Δ	Δ								
S/S RQMTS.	Δ		Δ	Δ								
SUPPORTING ANALYSES												
TECH. ANALYSES COMPLETE												
RELIABILITY AND SAFETY			Δ									
ANALYSES AND RECOMMENDATIONS			Δ									
DESIGN												
AVE												
SUBSYSTEMS DESIGN												
FUNCTIONAL DIAGS.		Δ		Δ								
COMP. RQMTS/IDENT.		Δ		Δ								
STAGE I RELEASE												
MODULES DESIGN												
COMP. DESIGN SHEETS - COMPLETE												
CRIT COMP. SPECS/CONTROL DWGS - COMPLETE												
PREL. MAKE/BUY DECISIONS - COMPLETE												
VENDORS RFP RESPONSES - COMPLETE												
AVE ITEMS CEI SPECS												
AGE												
PREL. DESIGN - DESIGN SHEETS												
PREL. CEI SPECS												

Figure 2-7. IMBLMS/Phase C - Major Milestone Schedule Part II - Technical

### 2.11.2 SCHEDULES BY TASK

The detailed Milestone Schedules for the tasks to the Level 2 and Level 3, as applicable, are provided in the Management Control Plan.

## 2.12 MANPOWER PHASING AND REQUIREMENTS

### 2.12.1 MANPOWER PHASING

The manpower requirements for the IMBLMS Phase C program have been developed based upon the task definitions of the Work Breakdown Structure. These direct labor manpower requirements have been consolidated and are shown time-phased in the Manpower Profile, Figure 2-8. As can be seen from this plot the requirement peaks in February 1968, at 40 equivalent applied people. Effort phases down to nominally 15 people for revision-updating work of Part II.

The work by other General Electric people outside the MOL Department, which appears as a material item, when converted to people, would add 10 equivalent people at the peak and an additional 3 people at either extreme of the profile.

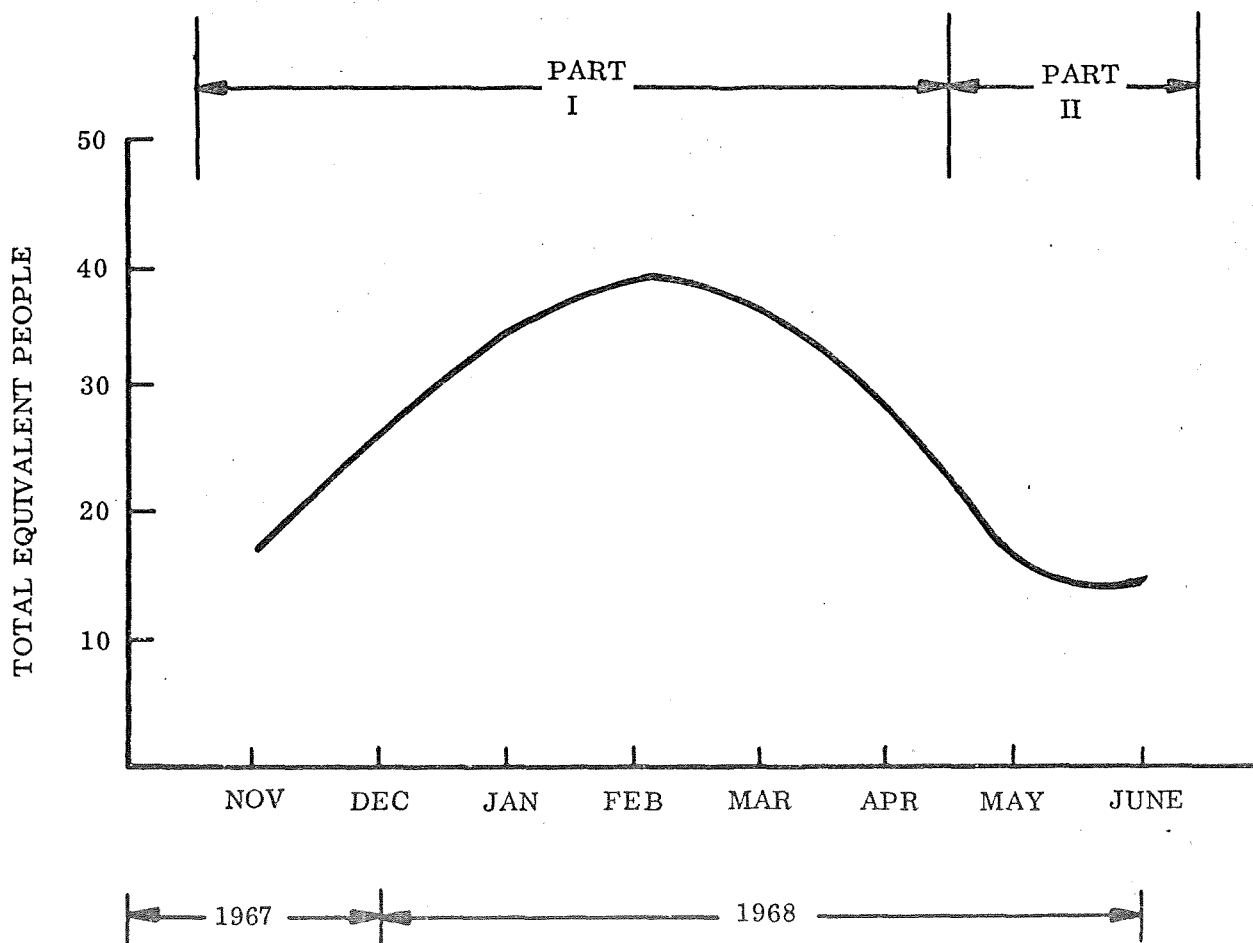


Figure 2-8. IMBLMS Phase C Manpower Profile

### 2.12.2 MANPOWER BREAKDOWNS

A breakdown of the manpower requirements in terms of both man-hours and equivalent average numbers of people are shown both by task and by organization. Table 2-1 Manpower by Tasks, shows the requirements by Level 1 and Level 2 tasks. The average number of people on the program totals 28.6 of which approximately one-third are the System Engineering task and another one-third the Design Engineering task.

Table 2-2, Manpower by Organizations, breaks out the requirement by organizational sections or units within the MOL Department. The largest single portion of the effort, over one-third, is drawn from the IMBLMS Engineering Operation.

The work by other General Electric people would add 6.1 average number of people to the total of 28.6 and these would be principally of the Systems Engineering type.

### 2.12.3 MANPOWER CONTROLS

The direct labor manpower that is allocated to each task will be in accordance with the Program Funding Instruction (PFI) which is issued by the Program Manager. This control thus exercised is of a fiscal nature and is described in Section 3.3 of this volume.

An immediate and specific manpower-oriented report used by the Program Manager is the "Weekly Shop Order Charges Report". This report which is issued promptly after the close of the week, identifies charges to the program by individual name/badge number and shop order number. Monitoring of this by the Program Office can reveal anomalies, prompt investigation and foster immediate adjustments to manpower assignments. Control of "indirect" manpower is discussed in the Management Plan.

Table 2-1. Manpower Breakdown By Tasks

Task	Name	Hours	Avg. People
<u>1000</u>	<u>Prog. Management</u>	<u>8,230</u>	<u>6.0</u>
1100	Proj. Engr. Mgt.	5,080	3.7
1200	Proj. Control	2,200	1.6
1300	Contracts & New Tech.	950	0.7
<u>2000</u>	<u>System Engr.</u>	<u>11,250</u>	<u>8.2</u>
2100	Syst. Rqmts.	3,828	2.8
2200	Syst. Analyses	5,172	3.8
2300	Syst. Dsgn & Integ.	2,250	1.6
<u>3000</u>	<u>Design</u>	<u>20,325</u>	<u>14.0</u>
3100	Flight Equipment	18,765	13.0
3200	Ground Support Equipment	1,560	1.1
<u>4000</u>	<u>Phase C Support &amp; Phase D Plng.</u>	<u>6,665</u>	<u>5.4</u>
4100	Mfg.	954	0.7
4200	QA & R	2,720	2.0
4300	ST & D	670	0.5
4400	Dsgn. Rel & Safety	2,990	2.1
	Total	47,149	34.7

Table 2-2. Manpower Breakdown By Organizations

Organization		Hours	Avg. People
7H10	Contr. Adm.	950	0.8
7H20		2,106	1.5
7K30	Finance	134	0.1
72A0	Design Reliability and Safety	2,990	2.1
72C0	Drafting	3,400	2.5
7300	QA&R	2,720	2.0
7410	Aero Medical	1,850	1.3
7430	Human Engineering	3,595	2.6
7440	IMBLMS Engineering	14,458	10.6
7450	Program Office	5,040	3.7
7580	ST & D	670	0.5
7660	Manufacturing	954	0.7
ASD		8,272	6.1
		<hr/>	<hr/>
		47,149	34.7

SECTION 3  
MANAGEMENT PLAN

## SECTION 3

### MANAGEMENT PLAN

#### 3.1 INTRODUCTION

The General Electric Company has established the MOL Department within the Missile and Space Division, incorporating the most significant manned orbital spacecraft capability that could be assembled within the Company. Because of the importance of the IMBLMS to the MOL Program, the IMBLMS team for Phase C has been established within the MOL Department. Included as team members are those employed in the Phase B study.

Figure 2-1, in Section 2 Program Plan, shows the corporate position of the MOL Department reporting vertically to the President of the General Electric Company. Figure 2-2 shows the organizational and functional responsibilities of each group within the MOL Department. Figure 2-3 shows the organization of the IMBLMS Program as the authority flows from Dr. Lawton.

#### 3.2 PROGRAM MANAGEMENT

##### 3.2.1 PROGRAM MANAGEMENT ORGANIZATION

The organization for Program Management of Phase C IMBLMS departs from the conventional line-staff organization normally used in the management of large or complex programs. It is a management concept which utilizes all of the strengths of the functional segments of the organization while pin-pointing specific responsibility for accomplishing a task. Under the Program Manager concept, responsibility is assigned to a single person, and it is he who establishes the objectives, develops the plans, determines the commitments, and evaluates the progress against schedule, cost, and technical performance.

A department General Manager is responsible for integration of the functional contributions of his organization where only one or two relatively stable programs are carried on at one time, the work of integration could be performed by the General Manager. However, where there are a number of complex and dynamic programs, the General Manager delegates his authority to his Program Managers.

The Program Manager is completely program oriented. The instructions from his program organization flow directly to the functional organizational level taking action. He is the focal point of communication between the Department and the customer's organization. While acting as the Department General Manager's delegate in managing the Program, the Program Manager is looked to by the customer for assurance of a quality product on time and within cost.

##### 3.2.2 SOURCE RESPONSIBILITY AND AUTHORITY OF THE PROGRAM MANAGER

Section 2, Figure 2-2 shows the MOL Department organization chart. Authorized members of the Business Management Section, acting for the Department General Manager, are

authorized to commit the Department by signing contracts. The same Figure 2-2 shows the flow of responsibility and of authority from the Department General Manager through the Bioastronautics Section to the IMBLMS Program Manager for conducting Phase C of the IMBLMS Program.

### 3.2.3 MEANS OF DELEGATING RESPONSIBILITY AND AUTHORITY FROM THE PROGRAM MANAGER

Section 2, Figure 2-3 shows the organizational relationship among the members of IMBLMS Program Management. Below this level, responsibility flows by standard means, i.e., functional charters, position descriptions, and other formal methods of delegating responsibility. Delegation of responsibility and authority from the Program Manager to various working levels in the functional organizations for program contributions is accomplished by use of the Program Funding Instruction (PFI), as described in paragraph 3.3.3.3

## 3.3 INTERNAL MANAGEMENT

### 3.3.1 UTILIZING MANAGEMENT CONTROL PLANS FOR PROGRAM AND TASK PROGRESS CONTROL

Program Management Control of program and task progress is delineated by Program Management Work Package Tasks at Level 2 of the Work Breakdown Structure (Section 4, Management Control Plans). Certain sections of the Management Plans may be identified as used in accomplishing this control by the Program Manager and his staff:

<u>WBS Level 2</u>	<u>Work Package Task</u>	<u>Management Plans (Paragraph Reference)</u>
Project Engineering	Interface Plan	2.3.2
Project Engineering	Configuration Plan	3.3.2
Project Engineering	Documentation Plan	5.0
Program Control	Schedule Control	3.3.1.1
Program Control	Cost Control	3.3.3
Program Control	Subcontract Management	3.4
Contract and New Technologies Administration		3.3.1.2

#### 3.3.1.1 Schedule Control

The lowest organizational level for which scheduling and control is implemented is the recipient of a Program Funding Instruction (PFI) as described in paragraph 3.3.3.3. Control of these schedules is integrated and consolidated into a key milestone schedule as part of the Phase C Program. The Integrated Milestone Reporting System (IMRS) will be used to control the schedules which have been committed to NASA.

### 3.3.1.2 Contracts and New Technologies Administration

Requirements of the New Technology clause, NASA Form 1162, will be complied with. The provisions of this form are as follows:

- a. Prompt reporting
- b. Frequent periodic reviews
- c. Written summaries of review activities
- d. Include New Technology clause in subcontracts
- e. Annual reporting on subcontracts over \$50,000
- f. Obtain subcontract certification of compliance
- g. Notification of first public use, sale, or publication of inventions.

A New Technologies Representative (NTR) will be appointed for the IMBLMS Program, specifically to implement compliance with the above requirements.

### 3.3.2 DESIGN CONTROL

#### 3.3.2.1 Design Release

During the Phase C Program, control of the design of equipment will be maintained in accordance with existing MOL Department Design Engineering Section Instructions describing the Engineering Stage Release System. In essence, this system is a time-phased systematic method of planning and documenting the availability and identification of the documents which contain the technical information associated with the development of the engineering design. There are two types of Stage Releases in the system: namely, 1) Engineering Development/Subsystem Release and 2) Component Release (applied to IMBLMS modules).

Phase C will take the design through Subsystem Stage I Release and generally through Stage I Component (module) release which includes maximum requirements and dimensions definition. The Engineering Development/Subsystem Stage Releases preceding the Component Stage I Release are as follows:

- |         |                                     |
|---------|-------------------------------------|
| Stage 0 | Examination of Work to be Done      |
| Stage I | Finalization of System Requirements |

Figure 3-1 shows the flow of information accompanying an Engineering Development/Subsystem Stage Release through Stage I. Figure 3-2 shows the same information for a Component Stage Release through Stage I.

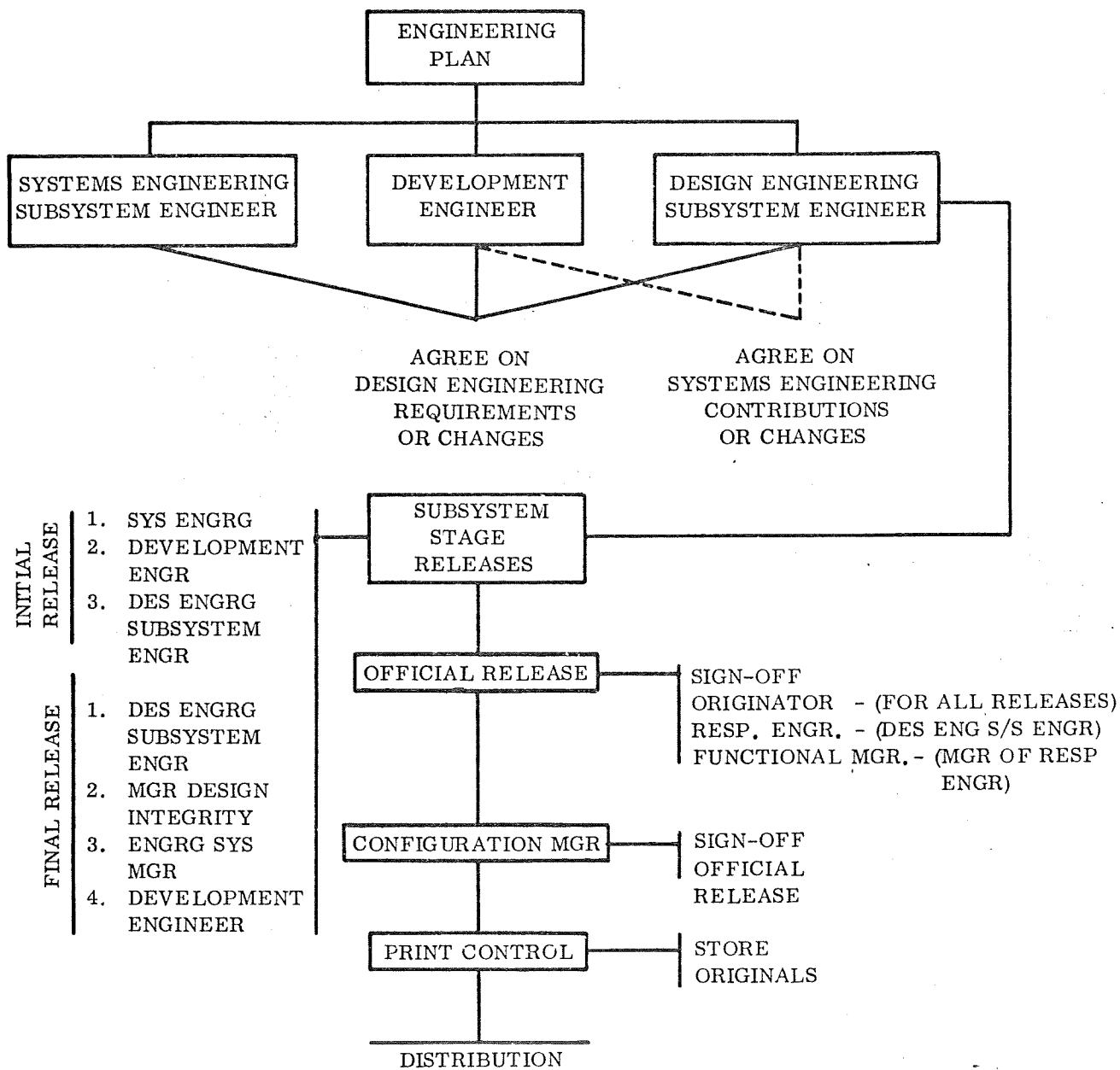


Figure 3-1. Typical Subsystem Stage Release Flow Chart

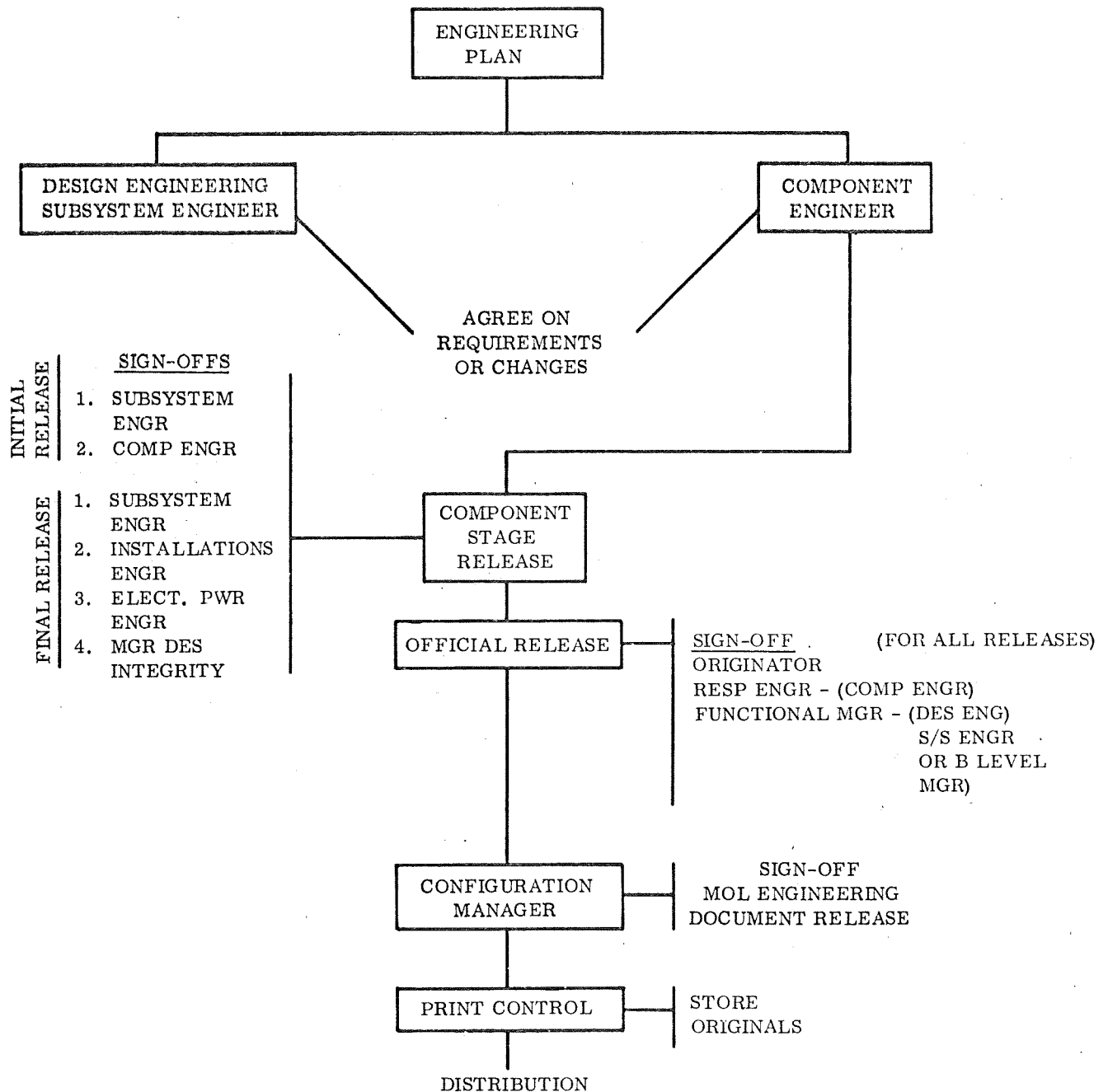


Figure 3-2. Typical Component Stage Release Flow Chart

### 3.3.2.2 Design Change

Formal customer-oriented configuration control does not become operative until Stage IV Component Release has been made. At this point, design change will fall under the formal controls to be prescribed in the Configuration Management Plan.

However, an integral design change control commensurate with the Preliminary Design stage of the program will be used: A planned cycle of early initial release update followed the mid-term concept review, and "final Phase C" configuration release is subjected to a change control on the technical design providing all concerned to work with a controlled baseline design.

The Configuration Management Plan will describe and outline the methods and procedures used in assuring proper configuration release, identification, control, and accounting during Phase D.

It will contain sufficient information concerning the following elements, to reflect GE-MOL Department competency to meet the objectives of Configuration Management as specified in NPC 500-1, Apollo Configuration Management Manual:

- a. Organizational structure and relationships (Administrative and Functional)
- b. Responsibility assignments
- c. Methods and responsibilities for baseline establishment, identification, and control, including the role that specifications play in this area
- d. Methods and procedures to be used in, and responsibilities for, control of changes in design
- e. Methods and procedures to be used and responsibilities for configuration accounting and configuration identification.

### 3.3.3 FINANCIAL MANAGEMENT

Meaningful and realistic budgets on a functional organization basis are established for both direct and indirect costs. Measurement against those budgets and reporting of variances to the appropriate level of management on a timely basis provide emphasis in those areas requiring corrective action.

#### 3.3.3.1 Financial Budget

##### 3.3.3.1.1 Direct Costs

Direct manpower and direct material costs are budgeted through the Program Funding Instruction (PFI) routine described in paragraph 3.3.3.3, Cost. Requirements are estimated by each

organization responsible for performing assigned work based upon the appropriate level of the Work Breakdown Structure. After evaluation of these requirements by the Program Manager, PFI's are negotiated with the responsible organization to establish the budget for the work. The total of these PFI's form the overall Program cost budget.

#### 3.3.3.1.2 Indirect Costs (Overhead and General and Administrative Expenses)

Budgets for indirect costs are established on a calendar year basis. Each Section within the Department submits its estimate of indirect manpower and indirect costs for the calendar year to the Finance Section. These estimates reflect the anticipated support effort and indirect expenses required to accomplish the direct contract effort.

On the basis of these inputs, the Finance Section compiles a Department budget for Engineering Overhead Expense, and for General and Administrative Expense. Evaluation is made by the Finance Section of the individual Section estimates and the overall Department estimate to assure compatibility of these estimates with the contract work load support requirements of the Department. Revisions recommended by the Finance Section on the basis of this evaluation are coordinated with the Section Managers to obtain their concurrence or recommendation for referral to the Department General Manager. Upon completion of the General Manager's review and incorporation of his recommendations, indirect cost budgets by Section are prepared for final approval by him. These approved Section budgets become the baseline against which each Section is measured. The consolidated Department budget forms the basis for the forward pricing and provisional billing rates proposed to the Air Force Plant Representative Office (AFPRO).

#### 3.3.3.2 Financial Control

Control of direct and indirect costs is accomplished through a systematic routine of reporting, measurement, and implementation of corrective action. Internal reports, some weekly and some monthly, reflect both current expenditures and year-to-date expenditures against the established budgets.

Indirect expense and manpower data are accumulated from the same sources as the direct costs and manpower; i.e., labor data comes from the Payroll System, and material and service data comes from the Accounts Payable System. The indirect budget functions the same as that of a direct cost shop order, except that the codes identify indirect expense classifications instead of subdivisions of the Work Breakdown Structure. Overhead and G & A Reports are issued monthly. These reports are at various levels of detail for close management control.

#### 3.3.3.3 Program Funding Instruction (PFI) Routine

Cost on Phase C will be controlled by the PFI/Financial Report method currently in use. PFI's will be used to budget the labor hours and material allocation by work package by month for the planned duration of the work package. Work packages are identified efforts having measurable starting and ending points, and are normally selected to cover periods such that

two packages for Part I of the Phase C Program and a separate package for Part II of the Phase C Program would be expected. This assures financial control by identified package of effort. Each PFI will have its own work statement and milestone schedule and will be negotiated by the Program Manager with the responsible operation and issued over his signature. Agreement will be reached, before starting work, on task to be accomplished, on the schedule, and on the estimated cost. Thereafter, the PFI scope and/or funding can be changed only by agreement between the performing operation and the Program Manager. Each week, following cost accrual for the preceding week, a computerized report will be issued to show the charges against each PFI and work package. The work progress against the previously agree-to milestone schedule will then be measured by the responsible operation and by the Program Manager.

Each PFI is, in effect, a contractual commitment by the performing organization to the Program Manager. The performing organization, with the assistance of the Program Manager, establishes a detailed schedule with measurable milestones, a budget (by task and for total work package), and detailed technical task definitions. The monitoring of work performance then becomes a matter of tracking completion of milestones (or estimating progress toward completion), of weekly cost accrual reports to measure expenditures against budgeted commitment, and review and judgement to ascertain the adequacy of technical performance. By initially assigning a budget to each task and then tracking expenditures for each task, the value of work performed is tracked and areas of potential or actual overrun are readily identified for corrective action. Each performing organization reports progress to Program Manager at least weekly, more frequently when problems arise.

#### 3.3.4 MANPOWER (STAFFING)

##### 3.3.4.1 Policy

The General Electric Manned Orbiting Laboratory Department is staffed to provide the number and types of people with the proper education, talents, and skills to accomplish the direct effort under the IMBLMS Phase C Program. It is also staffed with the types and number of indirect charge people required to support direct labor and to provide the necessary administrative effort.

In addition to its own staff, the Department may draw upon the manpower resources of other Departments of the Missile and Space Division as well as other departments and laboratories throughout the General Electric Company as required to fulfill its contract obligations.

##### 3.3.4.2 Manpower Control

Each Section Manager within the Department is charged with the responsibility of maintaining his staff of direct charge employees at the level that does not exceed that for which he is funded through the Program Funding Instruction (PFI) routine described in 3.3.3.3, thus providing two controls on direct manpower: first, by the Program Manager who controls the direct manpower for the Program by the PFI routine; and second, by the Section and lower level Manager who controls direct manpower in his organization by the sum total of all PFIs issued to him. Planning of indirect manpower and expenses is done on an organization basis (see 3.3.3.1.2).

### 3.4 SUBCONTRACT MANAGEMENT

#### 3.4.1 PHASE C ACTIVITIES

During Phase C, subcontractor activities involve the effort from vendor surveys and make/buy decisions through bids, and at the most subcontractor negotiation (Reference Make/Buy plan). For this effort, a full time Subcontracts Manager has been appointed. The Subcontracts Management tasks described below are largely Phase D tasks in the conduct of subcontracts; however, the effort in Phase C of preparing for Phase D contracts is directly based upon how anticipated subcontracts will be managed.

#### 3.4.2 ADMINISTRATION

A key element of procurement is the management and control of major subcontracts. General Electric is implementing the subcontractor "Project Manager" concept to ensure successful subcontract performance and control. The Subcontract Project Manager who reports to the Program Manager is responsible for all management and direction of subcontracts from make/buy decision through delivery, thus providing single-point authority. Supporting this approach, management control through Subcontract Program Operations and contractual control through Subcontract Business Management of the MOL Department provides the required management uniformity and visibility over all major subcontracts.

The Subcontract Project Manager is the single point of contact for all subcontract administrative activities, as appropriate to the specific procurement. The Subcontract Business Management Office of the MOL Department is responsible for all contractual communications with the subcontractor, maintaining current status of all contractual documents, open items, and the performance of all contractual negotiation and change actions.

Open items of a contractual nature are recorded, and an "Action Item List" is maintained and published weekly for administrative disposition. Subcontract closeouts and terminations are processed in accordance with General Electric procedures, consistent with Government regulations.

Each change to a subcontract is negotiated on its own merit whether the change is initiated by the subcontractor or GE-MOL. The proposal, review, negotiation and approval cycle used for the original subcontract is followed prior to amending a subcontract.

#### 3.4.3 TECHNICAL DIRECTION

Emphasis is placed on the implementation of clear, direct lines of communications for technical interchange, technical direction, management interchange, and formal subcontract direction. Six areas are emphasized: Program Control, Status Management, Evaluation and Appraisal, Action Planning, Technical Direction and Control, and Administration.

#### 3.4.4 TASK PROGRESS

Subcontractor communications are in the same patterns as that used within the GE-MOL Department. Direction of the subcontractor upon initiation of the subcontract is according to the Statement of Work as described in the Procurement Plan. Various methods are employed by Subcontract Program Operations to obtain valid status information, depending on the requirements of the specific subcontract. A list of these include:

- a. Subcontract program appraisal and review
- b. Periodic progress reports
- c. Periodic cost, value of work performed, schedule, manpower, and technical status reports
- d. Day-to-day verbal contact
- e. Program reviews (design and management)
- f. On-the-spot monitoring by Management, Engineering, and Quality and Reliability representatives

Both technical adequacy and progress are assessed in determining technical status, and the integration and verification of cost, schedule, and technical status information is performed to assess overall program posture.

#### 3.4.5 FINANCIAL CONTROL

In the case of cost-type and selected high cost fixed-price subcontracts, agreement is reached at negotiation with the subcontractor as to the level of funding required commensurate with manpower loading and design, development, and hardware cycles. Wherever practicable, incremental funding is employed on a short-term basis to limit the liability of GE and its customers. Subcontract financial accounting is maintained current based on reported actual spending. All subcontractor overtime expenditures on cost-type contracts requires the prior approval of GE. Formal monthly financial, manpower, and value of work performed, status report, developed to provide manpower and costing data at the work breakdown structure package level, is required. Financial management and control is performed through the evaluation and appraisal of such reports.

SECTION 4  
MANAGEMENT CONTROL PLAN

## SECTION 4

### MANAGEMENT CONTROL PLAN

#### 4.1 INTRODUCTION

The Management Control Plan (MCP) consists of a series of four individual MCP's which correspond to the organization of the Phase C work as defined in the WBS. This is in accordance with the first sentence of Phase B Work Statement, Section H.3, i.e., "Contractor's Organization" which has been interpreted to mean how the contractor shall organize the work for Phase C performance. (The management structure is described in the Program Plan - Section 2 of this Volume.) The total work content of Phase C has been partitioned into four Level-1 Subdivisions of Work (SOW) (see Figure 2-4, "IMBLMS Phase C Work Breakdown Structure"). The total work contained in all four SOW's represents 100 percent of the Phase C contract applied effort. Also, the WBS System used in the Management Plan (See Volume II, Section 3) requires that all subsequent lower subdivisions will also encompass 100 percent of the work contained in the parent SOW.

Each of the four MCP's is defined individually in the following sections. The coverage within each at the MCP level and at the individual lower level SOW's includes: (1) organizational unit and individual responsible; (2) task descriptions (conforming to the WBS System's Summary Task and Work Package Task) which include task products; (3) start and completion dates; (4) constraints and interface considerations; and (5) a summary of effort (man-months) spread over time. A major milestone schedule (total Phase C effort) is included in Figures 4-1 (Technical) and 4-2 (Management).

#### 4.2 MCP NO. 1000 "PROGRAM MANAGEMENT"

##### 4.2.1 LEVEL-1 SUMMARY TASKS

The Level-1 Summary Task is the responsibility of the Manager, IMBLMS Program. Mr. A. A. Little is the designated individual.

The basic Phase C tasks to be accomplished by Program Management are: (1) the planning and control of the contract's technical accomplishments, including interface management and documentation and configuration management; (2) the planning and control of cost and schedule performance (including subcontracting); and (3) basic administration of the contract, including the "New Technology Reporting" provisions. The active time period extends across all eight months of Phase C, covering both Parts I and II. Major milestones and schedules are shown in Figure 4-1.

- 1 BASED ON PHASE B  
 2 NASA REVISED INPUTS  
 3 BASED ON NASA INPUTS

- U UPDATE DURING PHASE C  
 F FINAL FOR PHASE C

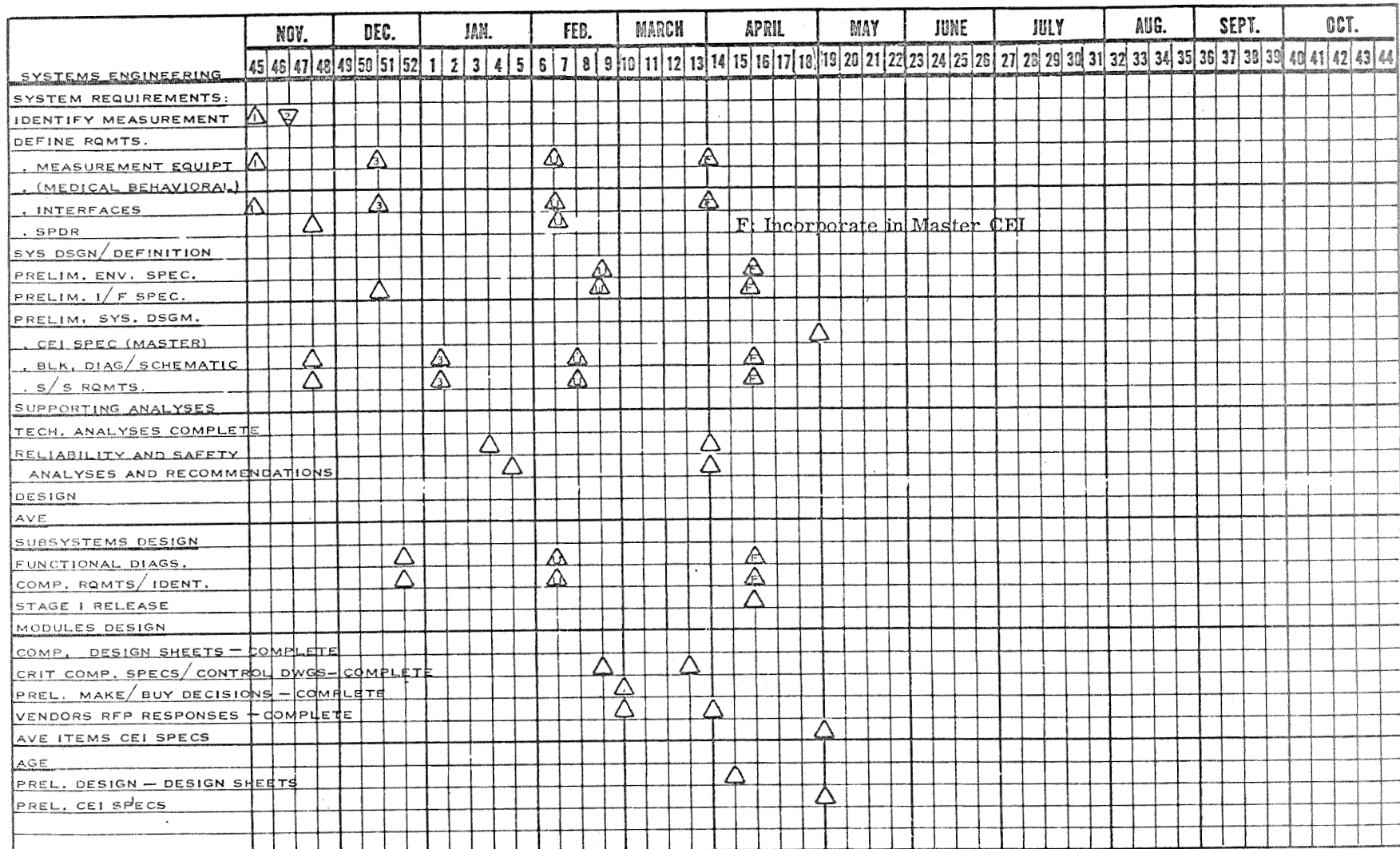
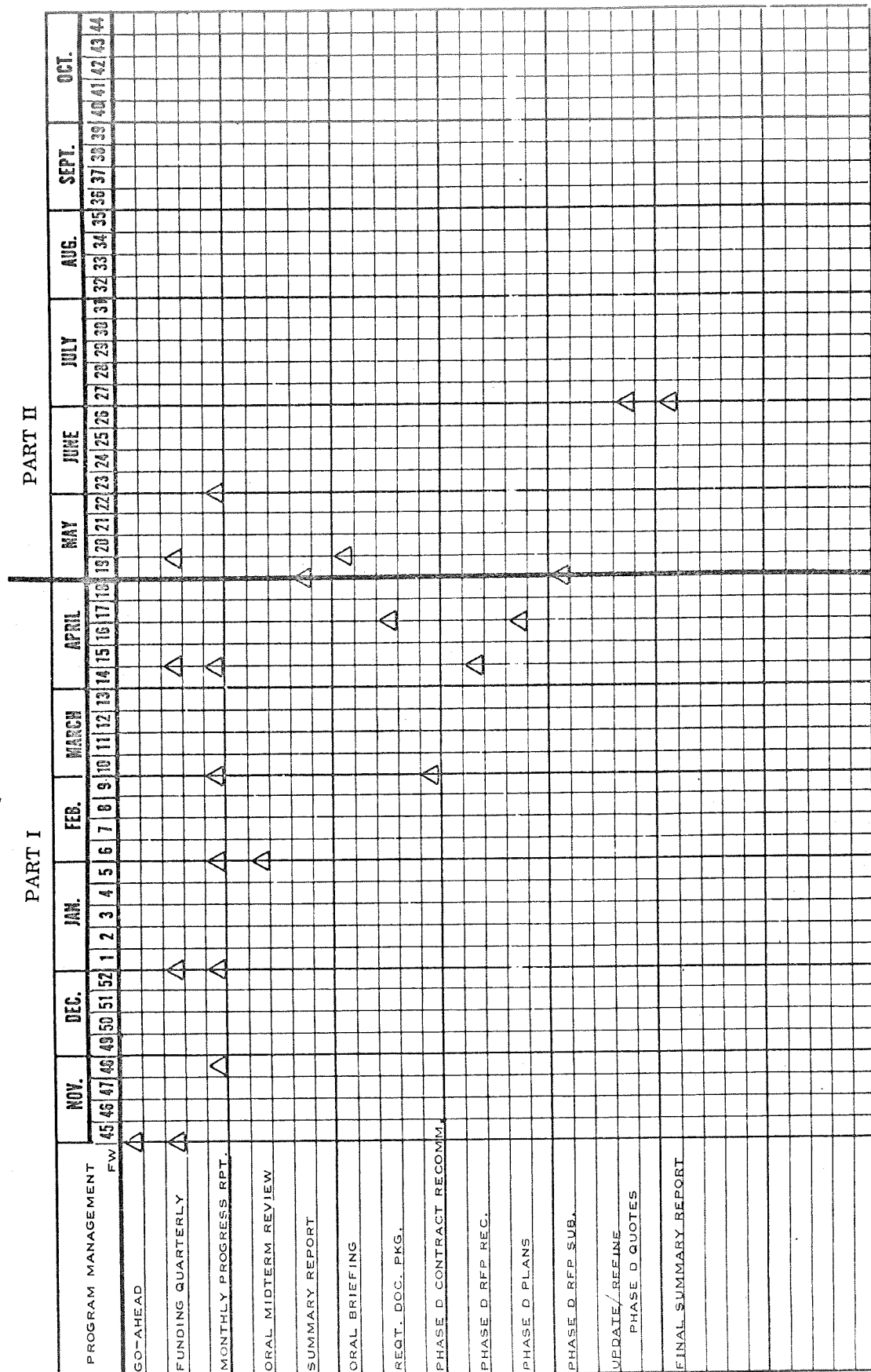


Figure 4-1. Phase C Master Technical Schedule



The planned total manpower and its allocation across the three level 2 summary tasks, is shown below:

<u>Task</u>	<u>Title</u>	<u>Hours</u>	<u>Average Heads</u>
1000	Program Management	8230	6.0
1100	Project Engineering	5080	3.7
1200	Integrated Program Control	2200	1.6
1300	Contract and New Technology Administration	950	0.7

#### 4.2.2 LEVEL-2 SUMMARY TASKS

The Level-2 Summary Tasks are planned as follows:

- a. Project Engineering, Summary Task No. 1100
  1. Responsible: T.C. Slugocki
  2. Products: Interface Management; Document Management (including publication); Configuration Control; control of technical adequacy of engineering and functional performance as necessary to meet contract requirements; provide Phase D plans.
  3. Schedule: See coverage in paragraph 4.2.3.
  4. Manpower: 3.85 Average Applied Heads
- b. Program Control, Summary Task No. 1200
  1. Responsible: (Individual to be named at start of Phase C)
  2. Products: Cost and schedule issuance, measurement, comparison, analysis, and recommendations; Phase D plans; subcontract planning and management.
  3. Schedule: See coverage in paragraph 4.2.3.
  4. Manpower: 1.5 Average Applied Heads
- c. Contract and New Technology Administration, Summary Task No. 1300
  1. Responsible: N. Cerone
  2. Products: Basic contract administrative services and implementation of New Technology Clause.

3. Schedule: See coverage in paragraph 4.2.3.

4. Manpower: 0.75 Average Applied Heads

#### 4.2.3 WORK PACKAGE TASKS

Work Package Tasks under the three Level-2 Summary Tasks have been planned as follows:

a. Project Engineering, Work Package Task No. 1110

1. Responsible: T. C. Slugocki

Products: On behalf of Program Manager, provide program project engineering leadership; lead planning, analysis of performance, and correction of problems across technical/cost/schedule lines; provide Phase D Management Plan.

Schedule: November, 1967 through June, 1968.

Manpower: Average 0.85 Applied Heads

2. Interface Management, Work Package Task 1120

Responsible: T. C. Slugocki

Products: Establish interface controls, interface specifications, interface liaison with customer, subcontractors and in-house functional organizations; provide Phase D interface Management Control Plan.

Schedule: November, 1967 through June, 1968

Manpower: 0.6 Average Applied Heads

3. Document and Configuration Management, Work Package Task No. 1130

Responsible: T. C. Slugocki

Products: Issue and monitor all documents and plans required by IMBLMS; establish and monitor configuration control of the design effort; provide Phase D Documentation and Configuration Control Plans.

Schedule: November, 1967 through June, 1968

Manpower: 2.25 Average Applied Heads

b. Under Program Control, Summary Task No. 1200

1. Internal Program Control, Work Package Task No. 1210

Responsible: Individual to be designated at start of Phase C.

Products: Issue integrated Cost/Schedule Baseline Plan for IMBLMS Phase C with Resource Allocations and summary milestones for all Summary Tasks and Work/Resource Authorizations (PFI's) and associated detailed milestone schedules for all Work Package Tasks implemented at the start of the contract. Cancel and issue PFI's with associated milestones as work package tasks are completed and new ones are to be started. Implement detailed system of measurement of cost and schedule actuals, comparing with plan and reporting variances.

Manpower: 0.8 Average Applied Heads

Schedule: Baseline Plan immediately on contract go-ahead; PFI's for downstream Work Package Tasks not less than two days prior to start; cost and schedule measurement/variance detection/analysis/reporting system on weekly and monthly cycle.

Timing: The planned time period coincides with the 6-month period of Part I; Work Package Task No. 1211 will be planned and issued, for cost control of the Part II Follow-on effort, two days in advance of Part II.

2. Subcontract Management, Work Package Task No. 1220

Responsible: D. Senyk

Products: Leadership and reporting of vendor surveys and contacts, secretary and recorder of Make or Buy and Source Boards; prepare and issue RFP's; Phase D Make-or-Buy Plan.

Schedule: Complete Make-or-Buy Structure by 1 March; receive/evaluate Phase D Subcontractor bids by 15 April.

Manpower: 0.7 Average Applied Heads

c. Under the Contract and New Technology Administration Summary Task No. 1300, there is a single Work Package Task, consisting of the following:

1. Contract and New Technology Administration, Work Package Task No. 1310

Responsible: N. Cerone

Products: Responsible for all contract negotiations and administration of the contract. Issuance of work authorization to Department. Maintain liaison with Customer Procurement personnel. Act as official spokesman for Company on all contractual matters, including negotiations. Is the officially designated recipient of customer communications, including logging, prompt review, and preliminary interpretation of communications; record maintenance of reply obligations and deadlines. Maintain contractual compliance with all aspects of the contract, including compliance with provisions of the New Technology Clause (May, 1966, including NASA Form 1162) including prompt written reports of each reportable item made by the Contractor (discovery, information, improvement or innovation) in performance of work described above.

Schedule: The Schedule Requirements for New Technology administration will involve procedure for implementation of the plan for promulgation of contractor's obligations issued no later than two weeks after Phase C Contract go-ahead. Submit two quarterly and one final New Technology Report 15 days after the end of the quarter and 30 days after contract completion.

Manpower: 0.8 Average Applied Heads

#### 4.3 MCP NO. 2000 "SYSTEM ENGINEERING"

##### 4.3.1 LEVEL-1 SUMMARY TASK

Level-1 Summary Task is the responsibility of the Manager, IMBLMS Engineering. Mr. G. L. Fogal is the designated manager. The basic tasks to be accomplished by System Engineering include: (1) analysis of the medical and behavioral characteristics (requirements) which are to be monitored/measured, relative to system parameters such as mission objectives and performance limits and constraints imposed by operational and design considerations; (2) analysis of the alternative system/subsystem parameters that can be employed to accomplish the integrated measurements, including system engineering trade studies; and (3) preparation of the specification documentation to define the system/subsystems identified by (1) and (2) in a format suitable for a Phase D (final design) contract. The active time period is across the entire Phase C period with schedules as shown in Figure 4-2. The planned manpower, with its allocation across the three Summary Tasks, is shown below:

<u>Task</u>	<u>Title</u>	<u>Man Hours</u>	<u>Average Applied</u>
2000	System Engineering	11250	8.2
2100	System Requirements	3828	2.8
2200	System Analysis	5172	3.8
2300	System Design and Integration	2250	1.6

#### 4.3.2 LEVEL-2 SUMMARY TASKS

The Level-2 Summary Tasks are:

- a. System Requirements, Summary Task No. 2100
  1. Responsibility: G. L. Fogal
  2. Products: Measurement requirements expressed for medical and behavioral data and System Program Design Requirements Specification.
  3. Schedule: See Figures 4-3 through 4-6.
  4. Manpower: 2.8 Average Heads
- b. System Analysis, Summary Task No. 2200
  1. Responsibility: G. L. Fogal
  2. Products: Analysis of system functions and concepts which satisfy the measurement requirements.
  3. Schedule: See Figures 4-7 through 4-10.
  4. Manpower: 3.8 Average Heads
- c. System Design and Integration, Summary Task No. 2300
  1. Responsibility: G. L. Fogal
  2. Products: Preliminary design definition for measurement system modules which satisfy the functions defined by Summary Tasks 2100 and 2200.
  3. Schedule: See Figures 4-11 through 4-14.
  4. Manpower: 1.6 Average Heads

#### 4.3.3 WORK PACKAGE TASKS

The Work Package Tasks under the Level-2 Summary Tasks are as follows:

- a. Under the System Requirements, Summary Task No. 2100

There will be Work Package Tasks for Biomedical Requirements, Behavioral Requirements, Crew System Interface Requirements and System Engineering Requirements.

B LEVEL OPER. NO.		OPER. NAME	PREPARED BY	DATE	APPROVED BY	DATE																						
TASK NO.	SUB-TASK NO.	DESCRIPTION OF DETAIL MILESTONES	ELAPSED TIME SCHEDULE																									
2100	2110	CREW SYSTEM INTERFACE REQUIREMENTS	(INDICATE YEARS) 1967 (SPECIFY CATEGORY)								1968																	
			WEEK																									
			45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		MAN/MACHINE-PHYSICAL/ OPERATIONAL REQUIREMENT																										
		GENERIC TASK SUPPORT EQUIP. RQMTS.																										
		HUMAN ENGINEERING RQMTS.																										
		EXPERIMENT ABORT PROCEDURES																										
		CREW TRAINING TASK CAPABILI- TIES REQUIREMENTS																										
		CREW TRAING. CONTENT & LEVEL RQMTS.																										
		CREW TRAING. PROGRAM RQMTS.																										
		MAN/MACHINE SAFETY RQMTS.																										
		CREW OPERATIONAL SAFETY RQMTS.																										

△ START    ▽ COMPLETE     TIME PERIOD OF WORK

↓ MAJOR ITEM EVENT (REPORT, HARDWARE DELIVERY, FLIGHT TEST, ETC.) - INDICATE ITEM NAME NEXT TO ARROW.

Figure 4-3. IMBLMS Phase C Phasing Schedule - Crew System Interface Requirements

Figure 4-3. IMBLMS Phase C Phasing Schedule - Crew System Interface Requirements (Cont)



TASK NO.		SUB-TASK NO.	OPER. NAME	PREPARED BY	DATE	APPROVED BY	DATE																							
2100		2120	BIOMEDICAL REQUIREMENTS	ELAPSED TIME SCHEDULE																										
				(INDICATE YEARS) 1967 1968 (SPECIFY CATEGORY) WEEK																										
			MEASUREMENT RECOMMENDATIONS	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
			MEASUREMENT EQUIP. MODULE																											
			RQMTS.																											
			MEASUREMENT INTERFACES																											
			RQMTS.																											
			APPROACH TO DOCUMENTATION																											
			RQMTS.																											
			CEI SPECS																											
			BUY SPECS																											
			PREL. TEST SPECS.																											
			PREL. RELIABILITY																											
			PREDICTIONS																											
			PREL. HAZARD ANALYSIS																											
			PREL. SYST. DESIGN RQMTS.																											
Δ START ↓		▽ COMPLETE ↘	TIME PERIOD OF WORK																											
MAJOR ITEM EVENT (REPORT, HARDWARE DELIVERY, FLIGHT TEST, ETC.) - INDICATE ITEM NAME NEXT TO ARROW.																														

Figure 4-4. IMBLMS Phase C Phasing Schedule - Biomedical Requirements

Figure 4-5. IMBLMS Phase C Phasing Schedule - Behavioral Experiment Requirements

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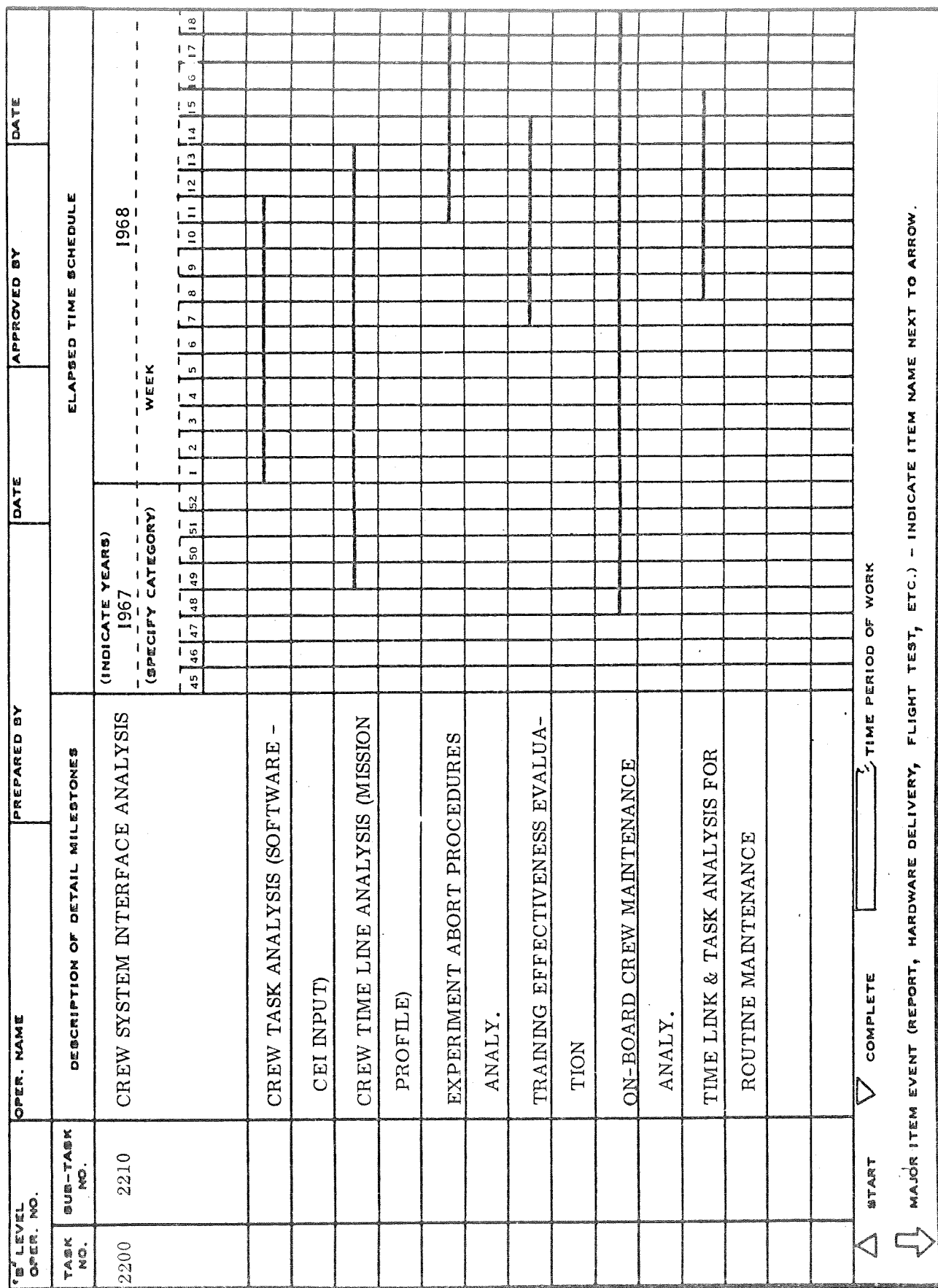


Figure 4-7. IMBLMS Phase C Phasing Schedule - Crew System Interface Analysis



Figure 4-9. IMBLMS Phase C Phasing Schedule - Behavioral Analysis



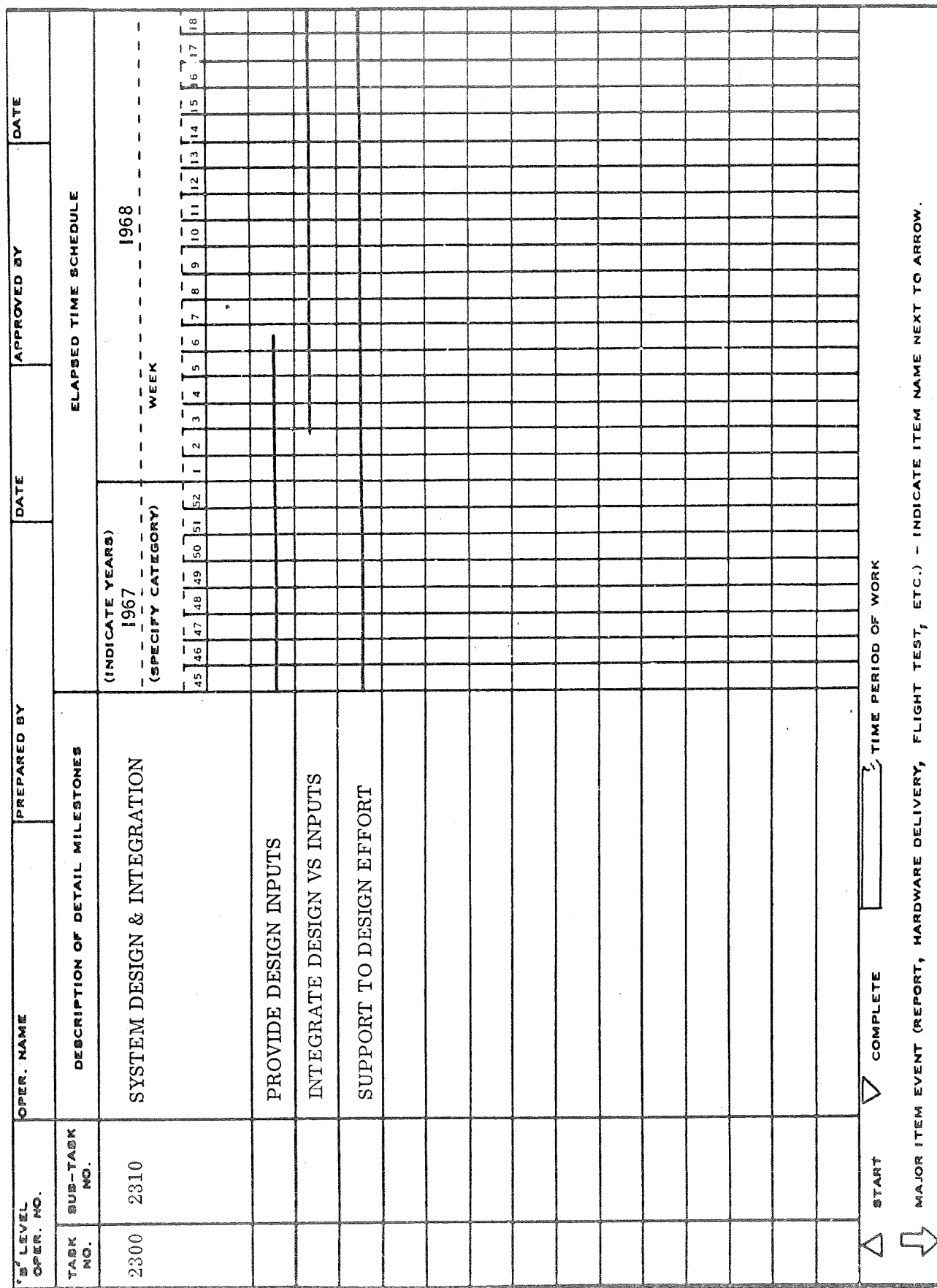


Figure 4-11. IMBLMS Phase C Phasing Schedule - System Design and Integration



Figure 4-13. IMBLMS Phase C Phasing Schedule - Behavioral Design and Integration



1. Crew System Interface Requirements, Work Package Task No. 2110

Responsibility: Dr. T. Marton

Products: Descriptions and definitions for man/machine interface requirements, plus requirements for the detection, isolation, diagnostic, and repair protocols; crew skills and training requirements; requirements for primary support hardware; requirements for access and work volume to hardware; and ancillary support hardware requirements. Also support for Phase D plans and proposal.

Schedule and Timing: See Figure 4-3.

2. Biomedical Requirements, Work Package Task No. 2120

Responsibility: Dr. M. G. Smyth

Products: Descriptions and definitions of measurements necessary for Biomedical Requirements; evaluation (trade studies) of measurement equipment, and generation of test requirements plus support for Phase D plans and proposal.

Schedule and Timing: See Figure 4-4.

3. Behavioral Requirements, Work Package Task No. 2130

Responsibility: Dr. T. Marton

Products: Descriptions and definitions of behavioral measurement requirements, evaluation of alternative measurement equipment, and generation of test requirements, plus support for Phase D plans and proposals.

Schedule: See Figure 4-5.

4. System Engineering Requirements, Work Package Task No. 2140

Responsibility: G. L. Fogal

Products: The preliminary systems requirement document, preliminary CEI Spec (Part I), preliminary requirements for system test, reliability, safety; and Phase D plans and proposal.

Schedule and Timing: See Figure 4-6.

- b. Under the System Analysis, Summary Task No. 2200, there will be Work Package Tasks for the same four basic areas as System Requirements.

1. Crew System Interface Requirements, Work Package Task No. 2210

Responsibility: Dr. T. Marton

Products: Trade study analyses of measurement requirements versus various system considerations, including the following: Crew task analysis, Crew time line analysis, experimental abort procedures, and on-board crew maintenance analysis plus support for Phase D plans and proposal.

Schedule and Timing: See Figure 4-7.

2. Biomedical Analysis, Work Package Task No. 2220

Responsibility: Dr. M. G. Smyth

Products: Trade Study analyses of biomedical measurements requirements versus interfaces with proposed equipment, plus analysis of resulting system data handling considerations, including hazards analysis. Also support for Phase D plans and proposal.

Schedule and Timing: See Figure 4-8.

3. Behavioral Analysis, Work Package Task No. 2230

Responsibility: Dr. T. Marton

Products: Trade study analysis of behavioral measurement requirements versus interface considerations with proposed equipment, analysis of resulting system data handling considerations, and hazard analysis plus support for Phase D plans and proposal.

Schedule and Timing: See Figure 4-9.

4. System Engineering Analysis, Work Package Task No. 2240

Responsibility: G. L. Fogal

Products: Trade study analyses of measurement requirements versus proposed equipment, considering various system parameters including thermal balance, EMC, stress, power, weight, safety, RFMA, controls, and reliability/redundancy, plus support for preparation of Phase D plans and proposal.

Schedule and Timing: See Figure 4-10.

- c. Under the System Design and Integration Summary Task No. 2300 there will again be Work Package Tasks for the same four areas.

1. Crew Interface System Design, Work Package Task No. 2310

Responsibility: Dr. T. Marton

Products: Preparation of preliminary system schematics which define the design requirements for effective measurement system/crew interface considerations.

Schedule and Timing: See Figure 4-11.

2. Biomedical/System Design, Part I, Work Package Task No. 2320

Responsibility: Dr. M. G. Smyth

Products: Preparation of preliminary system schematics and functional block diagrams for the biomedical measurement system plus support for Phase D plans and proposal.

Schedule and Timing: See Figure 4-12.

3. Behavioral System Design, Work Package Task No. 2330

Responsibility: Dr. T. Marton

Products: Preparation of preliminary systems schematics and functional block diagrams for the behavioral measurement system plus support for Phase D plans and proposal.

Schedule and Timing: See Figure 4-13.

4. System Engineering Integration, Work Package Task No. 2340

Responsibility: G. L. Fogal

Products: Preparation of preliminary design definition for the complete measurement system via system schematics, block diagrams, and interface control drawings, and system specification, plus support for the Phase D plans and proposal.

Schedule: See Figure 4-14.

#### 4.4 MCP NO. 3000 "DESIGN ENGINEERING"

##### 4.4.1 LEVEL-1 SUMMARY TASK

The Level-1 Summary Task is the responsibility of the Manager, IMBLMS Engineering. The designated individual is Mr. G. L. Fogal. The basic Phase C tasks to be accomplished by Design Engineering includes (1) the preliminary design documentation, in response to the specifications from system engineering to conceptually define the airborne system/subsystems that will accomplish the monitor/measure functions, and (2) develop the preliminary design documentation for the ground equipment required for checkout and operational support of the airborne equipment.

The active time period extends across all of Phase C, with key schedule dates shown in Figures 4-1 and 4-2. The planned total manpower and its allocation across the two Level-2 Summary Tasks, is shown below:

<u>Task</u>	<u>Title</u>	<u>Man Hours</u>	<u>Average Applied Heads</u>
3000	Design Engineering	20325	14.0
3100	AVE	18765	13.0
3200	AGE	1560	1.1

##### 4.4.2 LEVEL-2 SUMMARY TASKS

The Level-2 Summary Tasks are planned as follows:

a. Aerospace Vehicle Equipment (Summary Task 3100)

1. Responsibility: G. L. Fogal
2. Products: Electrical and Mechanical preliminary design definition of the on-board equipment.
3. Schedule: See Figure 4-15 through 4-17.
4. Manpower: 13.4 Average Heads

b. Aerospace Ground Equipment (Summary Task 3200)

1. Responsibility: G. L. Fogal
2. Products: Electrical and mechanical preliminary design definition of the ground-based equipment required to check out and service the system AVE.

Figure 4-15. IMBLMS Phase C Phasing Schedule - AVE-Data Management Module(s) Design

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II. 4-27

Figure 4-17. DMBLMS Phase C Phasing Schedule - AVE-Packaging Design (Structure Internal Wiring/Plumbing)

3. Schedule: See Figures 4-18 and 4-19.

4. Manpower: 1.1 Average Heads

#### 4.4.3 WORK PACKAGE TASKS

The Work Package Tasks under the Level-2 summary tasks are as follows:

- a. Under the Aerospace Vehicle Equipment (AVE) Summary Task there are Work Package Tasks for the design of (1), Data Acquisition and Conditioning AVE (2) Data Storage and Transmission AVE, and (3) AVE Packaging Design.

1. Data Acquisition and Conditioning, Work Package Task No. 3110

Responsibility: G. L. Fogal (Sub-organization responsible designee will be named prior to start of Phase C).

Products: Define requirements for subsystem module designs (from documentation generated by MCP 2000) and develop preliminary AVE design drawings, interface drawings, block diagrams and design specifications plus support for Phase D plans and proposal.

Schedule: See Figure 4-15.

2. Data Storage and Transmittal, Work Package Task No. 3120

Responsibility: G. L. Fogal (Sub-organization responsible designee will be named prior to start of Phase C).

Products: Determine requirements for data storage and transmission module designs (from documentation supplied by NCP 2000) and develop preliminary AVE design drawings, interface drawings, block diagrams and design specifications plus support for Phase D plans and proposal.

Schedule: See Figure 4-16.

3. Packaging Design, Work Package Task No. 3130

Responsibility: G. L. Fogal (Sub-organization responsible designee will be named prior to start of Phase C).

Products: Determine preliminary requirements and develop conceptual approach to system packaging methods for module designs; generate preliminary structure/design, interface drawings and preliminary specifications, including requirements for Phase D plans and proposal.

Schedule: See Figure 4-17.

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Figure 4-18. IMBLMS Phase C Phasing Schedule - AGE Conceptual Design - Electrical



- b. Under the Aerospace Ground Equipment (AGE) Summary Task there are Work Package Tasks for Electrical Design and for Mechanical Design of AGE.

1. Electrical Design of AGE, Part I, Work Package Task No. 3210.

Responsibility: G. L. Fogal (Sub-organization responsible designee will be named prior to start of Phase C).

Products: Determination of preliminary electrical requirements and generation of conceptual electrical design of the equipment required to check out and service the on-board AVE, generate preliminary design drawings, preliminary interface drawings and specifications, and support for the Phase D plans and proposal.

Schedule: See Figure 4-18.

2. Mechanical Design of AGE, Part I. Work Package Task No. 3220

Responsibility: G. L. Fogal (Sub-organization responsible designee will be named prior to start of Phase C).

Products: Determination of preliminary mechanical requirements and generation of conceptual mechanical design of the equipment required to check out and service the on-board AVE, generate preliminary design drawings, preliminary interface drawing and specifications, and support of the Phase D plans and proposal.

Schedule: See Figure 4-19.

4.5 MCP NO. 4000 "PHASE C TECHNICAL SUPPORT AND PHASE D PROPOSAL SUPPORT"

4.5.1 LEVEL-1 SUMMARY TASK

The Level-1 Summary Task is the responsibility of the Manager, IMBLMS Program Management. The designated individual is Mr. A. A. Little. The basic Phase C work to be accomplished by this summary task is that of (1) supplying the necessary expertise from the basic functional areas of Manufacturing, System Test and Deployment, Quality Assurance and Reliability, Design Reliability, and Safety, required to support a complete System Engineering and Design Engineering effort (MCP No.'s 2000 and 3000), and (2) contributing similar expertise as required for planning and work statement preparation needed for the Phase D proposal.

The active time period extends across all of Phase C. The Key schedule dates are shown in Figure 4-1. The planned total manpower and its allocation across the four summary tasks, is shown below:

<u>Task</u>	<u>Title</u>	<u>Hours</u>	<u>Average Applied Heads</u>
4000	Phase C Support and Phase D Planning	6664	5.4
4100	Manufacturing	954	0.7
4200	QA and R	2720	2.1
4300	ST and D	620	0.5
4400	Des. Rel. and Safety	2290	2.1

The next tier of the Work Breakdown Structure consists of Work Package Tasks.

#### 4.5.2 WORK PACKAGE TASKS

##### a. Manufacturing Support, Work Package Task No. 4100

1. Responsibility: J. Spiewak
2. Products: Support to System and Design Engineering, including produceability studies, production planning, and purchase quotations; Phase D Manufacturing Plan.
3. Schedule: See Figure 4-20.
4. Manpower: 0.7 Average Heads

##### b. Quality Assurance and Reliability Support, Work Package Task No. 4200

1. Responsibility: H. Brandt
2. Products: Support to Engineering; Selected Materials and Processes Lists; vendor quality requirements; CEI specifications, Pt. I, Section 4, FMEA; quality planning; Phase D Quality Assurance and Reliability Plans as noted in Figure 4-21.
3. Schedule: See Figure 4-21.
4. Manpower: 2.1 Average Heads

##### c. System Test and Deployment Support, Work Package Task No. 4300

1. Responsibility: J. Janus
2. Products: Phase D Integrated Test Plans, Logistics and Training.

Figure 4-20. IMBLMS Phase C Phasing Schedule - Manufacturing Support, Phase C, and Phase D Planning



3. Schedule: See Figure 4-22.
  4. Manpower: 0.5 Average Heads
- d. Design Reliability Support, Work Package Task No. 4400
1. Responsibility: W. Olewinski
  2. Products: Support to Engineering; Reliability trade-offs and predictions; environmental specification; Selected Parts List; specifications formatting; Phase D Safety Plan and Reliability Plan major contribution.
  3. Schedule: See Figure 4-23.
  4. Manpower: 2.1 Average Heads



Figure 4-23. IMBLMS Phase C Phasing Schedule - Design Reliability and Safety

SECTION 5  
PHASE C DOCUMENTATION PLAN

SECTION 5  
PHASE C DOCUMENTATION PLAN

5.1 INTRODUCTION

5.1.1 PURPOSE

This plan describes the Document Management Program which will be implemented for the IMBLMS Program during Phase C. It sets forth the policies, responsibilities, authorities and procedures that will govern the administration and implementation of the program. Note: Wherever the term "data" is used herein it is in lieu of the word document.

5.1.2 SCOPE

The plan covers contractor activities required to establish document requirements, to provide responses thereto, and to handle and process documents.

5.1.3 SUMMARY

This plan is responsive to the objectives and requirements of document management pertinent to a program of the size and scope of the IMBLMS Phase C contract and of sufficient depth to form the basis of a document management plan for IMBLMS Phase D. The key features of the plan are:

- a. Document management is established as an IMBLMS management support operation. The generation, preparation, production and reproduction of documents remain the responsibility of the appropriate management/support operations.
- b. Document Management encompasses not only the acquisition and management of documents across contractual interface but also the management of in-house documents.
- c. Requirements for documents are established by the users thereof and are validated on the basis that the documents identified are essential to the effective accomplishment of an authorized work package.
- d. Existing facilities and operating procedures are used to the maximum extent.

5.2 REQUIREMENTS

The principal objectives and requirements which govern the document management program are stated in paragraphs 5.2.1 and 5.2.2.

### 5.2.1 OBJECTIVES

The overriding document management objective is to assure that all documents essential for contract fulfillment are available and effectively submitted and distributed. Important subordinate objectives are to insure that -

- a. Only minimum essential documentation is generated or acquired.
- b. All documents are generated or acquired to meet specific user requirements and that the documents provided effectively fulfill these requirements.
- c. All documents are effectively integrated with respect to compatibility and consistency.

### 5.2.2 SPECIFIC REQUIREMENTS

The basic document management functions that the contractor is responsible for performing are described below:

- a. Establish and operate a Document Management Office to administer and monitor the implementation of the IMBLMS Document Management Program.
- b. Establish the data items essential for contractor operations. This function covers the identification and definition of the requirements, their validation and approval, and the imposition on responding operations.
- c. Establish schedules, costs, and quality criteria for identified data items. This includes generation, preparation, production and reproduction and the monitoring of performance against them.
- d. Establish and operate a document acquisition and dissemination system.
- e. Establish the applicability of the above to subcontractors, suppliers and vendors.

### 5.3 ORGANIZATION

Figure 5-1 shows the organization of the document management operations and their relationships to the overall IMBLMS organization.

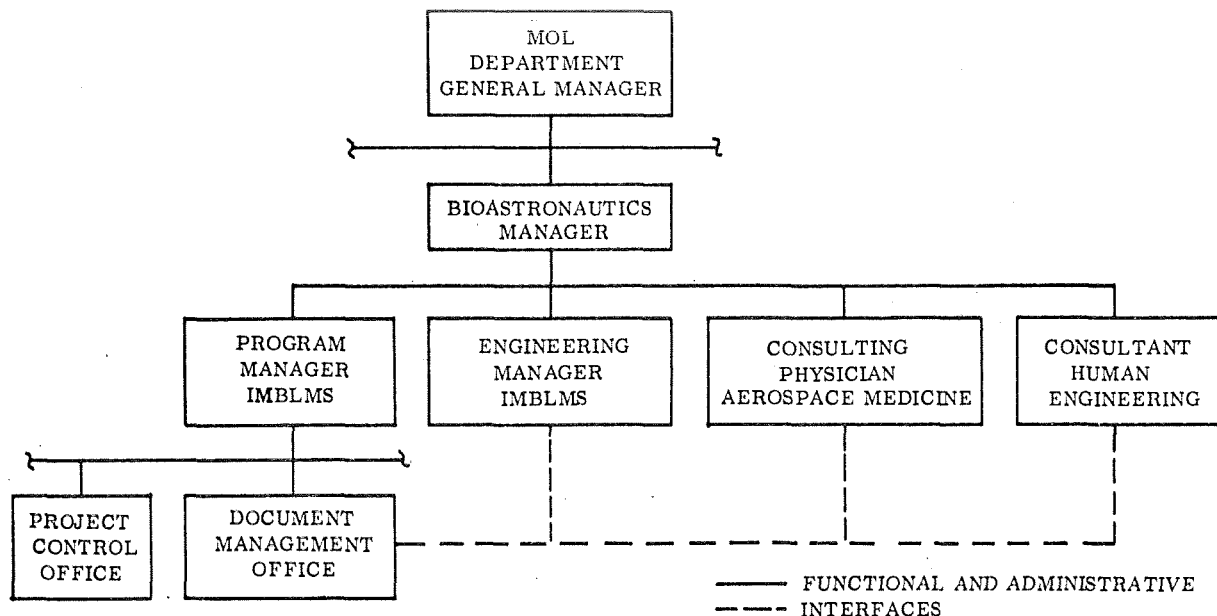


Figure 5-1. IMBLMS Phase C Organization

### 5.3.1 DOCUMENT MANAGEMENT OFFICE

The four basic functions that are the responsibility of the IMBLMS Document Management Office are summarized below:

#### 5.3.1.1 Establishment of Document Requirements

- a. Establish and implement Data Review Board (DRB)
- b. Identify data items required to perform the contractor role.
  1. Prepare Data Item List (DIL)
- c. Integrate data requirements across organizational levels.
  1. Obtain DRB approvals of DIL's
- d. Define data requirements
  1. Prepare Data Requirements Descriptions (DRD)
  2. Prepare Data Requirements Lists (DRL)

- e. Analyze customer requirements
  - 1. Recommend additions/deletions

#### 5.3.1.2 Data Generation and Publication

In order to satisfy this basic function, the IMBLMS Document Management Office is responsible for:

- a. Providing assistance to the cognizant functional managers in establishing data generation, preparation, and production and reproduction schedules.
  - 1. Provide schedules
- b. Monitor status against schedules
- c. Assure data quality/conformance
  - 1. Establish quality criteria
  - 2. Conduct quality reviews
- d. Arranging for document production and reproduction

#### 5.3.1.3 Document Handling and Processing

In order to satisfy this basic function the IMBLMS Document Management Office is responsible for:

- a. Identification of methods and procedures for the acquisition and release of data
  - 1. Provision of methods and procedures
- b. Arranging for document storage facilities
- c. Arranging for requested document retrieval
- d. Arranging for document distribution and submittal

#### 5.3.1.4 Subcontractor Document Management

The IMBLMS Document Management Office will to the extent necessary in Phase C

- a. Assist in preparation of DRL to be imposed on subcontractors
- b. Assist in the subcontractor negotiations relative to document preparation, delivery, and cost.

### 5.3.2 DATA REVIEW BOARD (DRB)

The DRB will have overall responsibility for the review and approval of the data requirements imposed by the DRL, DIL, and the DRD's, which describe the documents to be generated and published in fulfilling contract requirements.

The DRB has functional responsibility for:

- a. Review of all proposed data requirements against, need, impact on cost and schedule, standardization within organizational levels and types.
- b. Approval/Rejection of proposed DRD's
- c. Review of data requirements to be placed on subcontractors.
- d. Integration and consolidation of final requirements including those which are customer imposed.
- e. Approval of response schedules
- f. Recommendation of alternate document submission and schedules.

The DRB membership will be as follows:

#### Permanent Members

Chairman - IMBLMS Program Manager  
Secretary - Documentation Manager  
Program Control Manager  
Engineering Manager  
Subcontracts Manager

#### Ad Hoc Members

Reliability & Quality Assurance  
Systems Test & Deployment  
Safety  
Manufacturing  
Finance  
Contracts Administration  
Medical Consultant  
Human Factors  
Interface Management

## 5.4 PLAN

### 5.4.1 IMPLEMENTATION

Figure 5-2 shows the document management implementation schedule for the Phase C program.

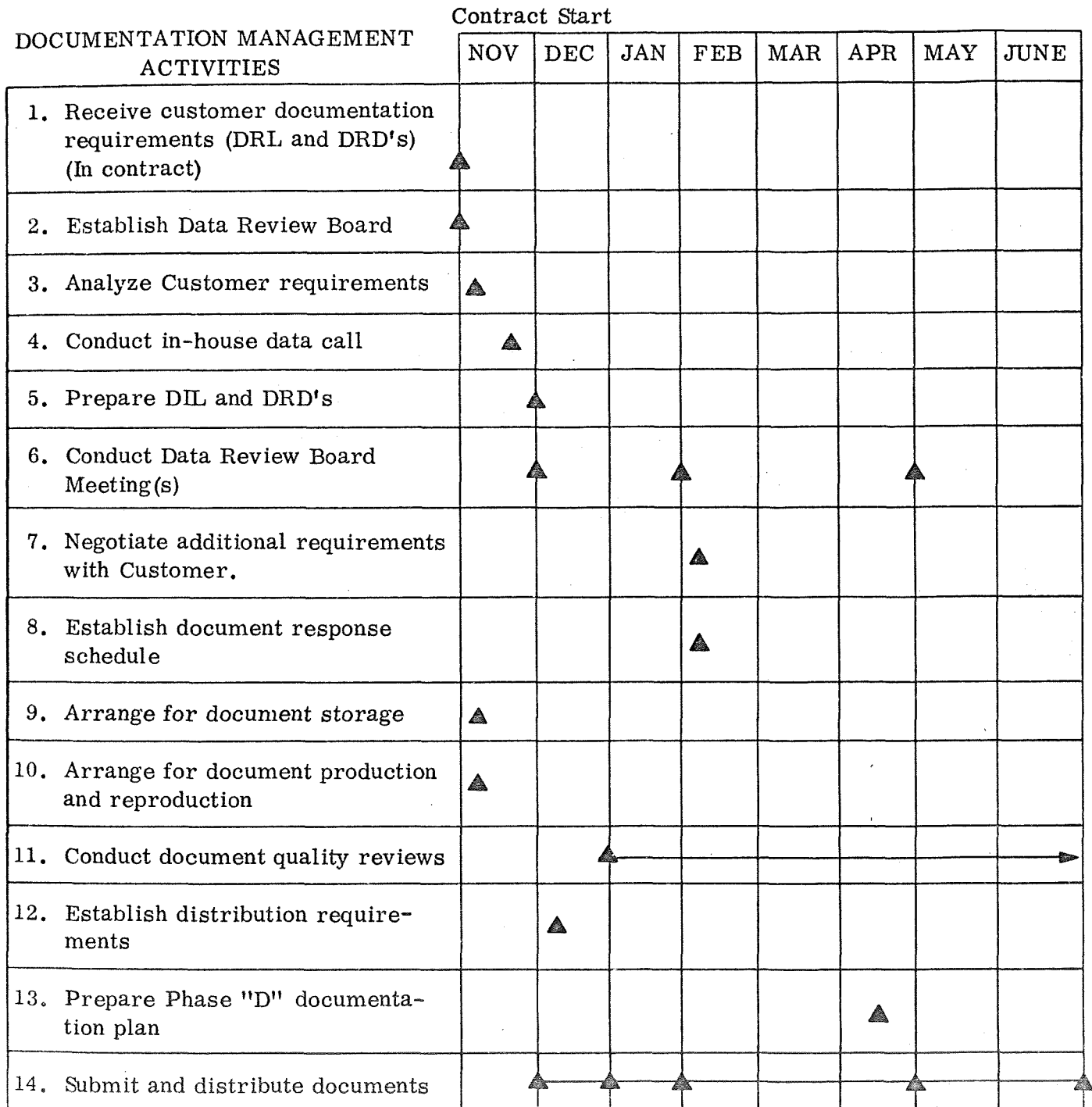


Figure 5-2. Phase C Document Management Implementation Schedule

#### 5.4.2 ESTABLISHMENT OF DOCUMENTATION REQUIREMENTS

The documentation requirements will be based on the contract work statement, contract general provisions, the contractually imposed Data Requirements List, and data items identified as needed by the Contractor to perform his role. Table 5-1 shows the documents which are anticipated for Phase C:

Table 5-1. Phase C Documents

IMBLM System Specification
IMBLM System Master CEI Specification
Mechanical AGE Master CEI Specification
Electrical AGE Master CEI Specification
Training Equipment Master CEI Specification
Prime Equipment CEI Specification (10)
Computer Software CEI Specification (3)
Engineering Critical Component Specification (10)
Identification Item CEI Specification (10)
Procurement Specification (35)
Environmental Specification
Interface Specifications (5)
Selected parts, materials, processes lists (1 each)
Analyses (7)
Drawings (as required)
Reliability predictions, trade-offs, failure mode and effect analyses
Safety hazard analyses
Management Plans (20)
Test Requirements and Specs (38)
Integrated Test Plan
Progress Reports
Midterm Report
Final Report
Phase "D" RFP response
Midterm and final briefing charts

##### 5.4.2.1 Data Call

After receipt and analysis of the customers data requirements (DRL) the Document Manager will conduct a data call. This call will be placed on the IMBLMS functional managers and will in effect ask them what documents are required by them to conduct their portion of the business. The managers will be asked also to compare their requirements against those of the customer and recommend any additions, deletions, or combinations. These activities will result in the preparation and presentation of a Data Item List (DIL) to the Data Review Board for the review and approval of the recommendations.

#### 5.4.2.2 Data Review Board

The DRB will review the identified requirements approve or reject or recommend consolidation, assign preparation responsibilities, assess schedule impact, and in conjunction with the Document Manager prepare and release the official Data Requirements List and Data Requirements Descriptions.

#### 5.4.3 DOCUMENT GENERATION AND PUBLICATION

All documentation resulting from the DRL and DRD requirements will be prepared and published in accordance with the specified formats and other requirements.

##### 5.4.3.1 Quality Review

All documents will be reviewed by the Document Management Office prior to their submittal for conformance to specified requirements.

##### 5.4.3.2 Production and Reproduction

Production (Technical Publication) and reproduction activities will be performed by in-place facilities and resources. Arrangement for support services will be made by the Document Manager in accordance with schedule requirements.

#### 5.4.4 DISTRIBUTION AND SUBMITTAL

The Document Manager will determine distribution requirements, prepare distribution lists, and monitor performance. Submittal will be made in accordance with customer dictates for form, quantity, schedule and addressee.

SECTION 6

PHASE C MAKE OR BUY PLAN

## SECTION 6

### PHASE C MAKE OR BUY PLAN

#### 6.1 INTRODUCTION

General Electric Missile and Space Division has an established policy of utilizing the best designs and equipments, at the highest echelon, from whatever source available. However, in no case does General Electric abrogate its responsibility for system engineering, interface specifications, nor the accountability for supplier's performance.

For IMBLMS, the following general make or buy pattern is foreseen:

- Buy items will fall largely in the medical/chemical analysis/behavioral equipment areas.
- Make items will involve structures, a portion of the data management elements, and items of discrete, specific characteristics of new design for this program.

##### 6.1.1 PURPOSE

This plan describes the Make or Buy (M/B) Program which will be implemented for the IMBLMS Program during Phase C. It sets forth the policies, responsibilities, and procedures that will govern the administration and implementation of the make or buy program. As certain vendors will be selected during Phase C, Section 6.4 of the plan briefly describes source selection board activity.

##### 6.1.2 SCOPE

The plan covers the contractor activities in relation to the establishment of make or buy policies and decisions.

##### 6.1.3 SUMMARY

This plan is responsive to the objectives and requirements of a make or buy program pertinent to the Phase C contract and of sufficient depth to form the basis of a make or buy program for IMBLMS Phase D. Key features of the plan are:

- The make or buy program is a part of the total MOL Department procurement plan as documented in MOL Department Policy 4.00 attached.
- Make or buy decisions are made at the management level (Make or Buy Board).
- Source selection decisions are made at the management level by the Source Selection Board.

- Disposition of all items whose estimated cost is at least \$10,000, and all high risk items or development projects, regardless of price, are decided by the M/B Board.
- Advantage is taken of previous surveys by the MOL Department for IMBLMS in assessing potential vendor capabilities and facilities.
- Make or Buy Criteria are responsive to NASA Procurement Regulation 3-902.
- Source selection criteria are responsive to NASA Publication NPC 402.

## 6.2 OBJECTIVES

The make or buy objectives of the IMBLMS program are as follows:

- Use only vendors with proven capabilities and facilities wherever feasible.
- Use existing and proven (or easily modified) equipments wherever possible.
- Insure lowest realistic cost meeting quality, reliability and performance requirements.
- Insure recognition and consideration of special capabilities peculiar to the General Electric company, subcontractors, vendors, or academic institutions.

## 6.3 ORGANIZATION

Figure 6-1 shows the organizational relationships used in the implementation of the make or buy program.

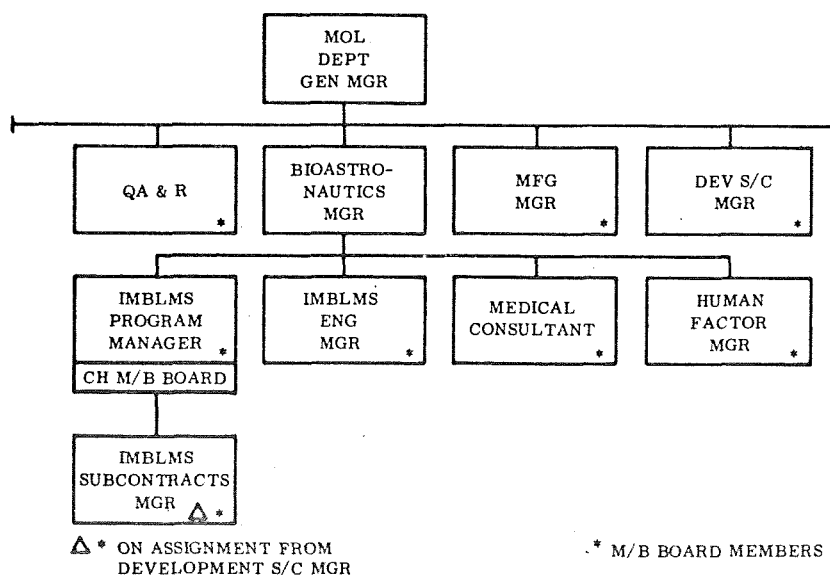


Figure 6-1. Make or Buy Board Organization

### 6.3.1 RESPONSIBILITIES

#### 6.3.1.1 Program Manager

The Program Manager will

- Be responsible for implementing the overall make or buy program and source selection activities tailored to IMBLMS needs.
- Function as chairman of M/B Board; establish Board procedures, schedule and convene meetings and appoint working groups as required.
- Identify items which require M/B decision.
- Prepare a listing of all M/B decisions and potential sources of each item.
- Function as Chairman of the Source Selection Board.

#### 6.3.1.2 IMBLMS Subcontracts Manager on Behalf of the Program Manager

- Act as permanent secretary to the M/B Board.
- Prepare RFP's as required.
- Establish and maintain M/B activity schedules compatible with Program Schedules.
- Maintain M/B decision records.

#### 6.3.1.3 IMBLMS Subcontracts Manager, Engineering, Medical, Human Factors

- Analyze total work to determine packages suitable for make or buy decision.

#### 6.3.1.4 Development Subcontracts Management, Manufacturing, Engineering, QA&R

- Contribute to RFP preparation and support surveys.
- Provide data as appropriate to support a thorough evaluation of M/B items and participate in the evaluation process.
- Prepare RFP's as required.

#### 6.3.1.5 System Test and Deployment

- Provide inputs as required.

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#### 6.3.1.6 Finance

- Review cost analysis quotations and financial resources of proposed vendor/subcontractors.
- Participate in fact finding and negotiations.

### 6.4 PLAN

#### 6.4.1 IMPLEMENTATION

Figure 6-2 shows the make or buy program implementation schedules for the Phase C program.

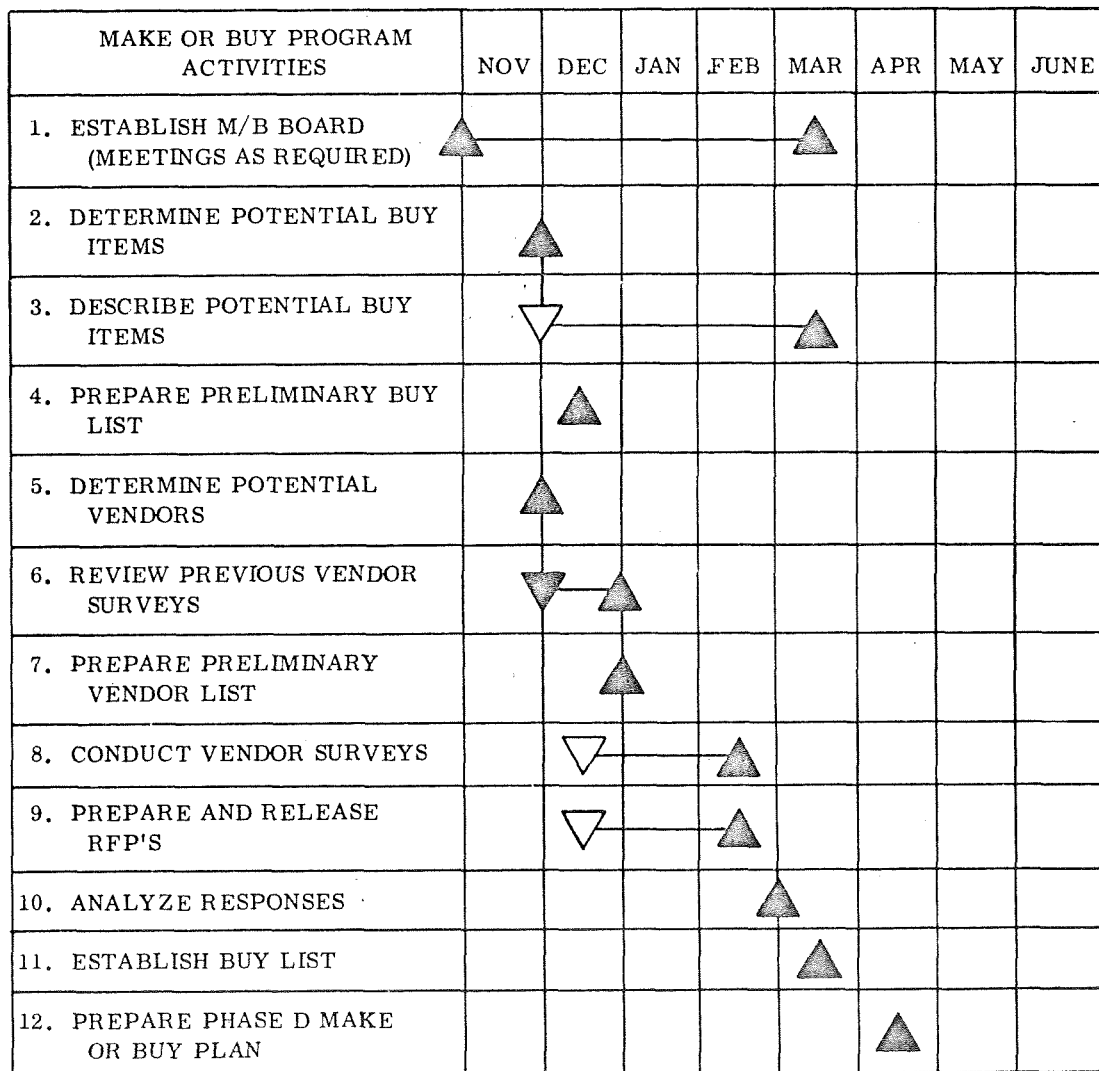


Figure 6-2. Phase C - Make or Buy Program Implementations

#### 6.4.2 MAKE OR BUY "PACKAGE" DETERMINATION

Packages suitable for make-buy decisions will be developed based on the following considerations:

- Consistency with customer and system requirements
- Each package a complete task
- Each package to have "clean" interfaces to degree feasible
- Each package or family of packages compatible with industry capabilities

#### 6.4.3 MAKE OR BUY CRITERIA

The following criteria will be used as a basis for making the M/B decision:

- a. Customer Requirements
- b. General Electric Capability and Capacity
- c. Industry (Vendor and/or Subcontractor) Capability and Capacity
- d. Relative Cost and Schedules
- e. Design Status and interface definitions status
- f. Product Quality
- g. Small Business Participation and Labor Surplus Areas

A make or buy working group will prepare a comparison of General Electric and industry capabilities for each M/B decision, review available data, and make a recommendation to the M/B Board. The data for these recommendations will come from GE Manufacturing and Engineering and surveys of potential vendors.

#### 6.4.4 GE MANUFACTURING AND ENGINEERING REVIEW

GE-MOL Manufacturing and Engineering will review each work "package" to determine whether a capability is available within the MOL Department or other Departments of General Electric for the effort under consideration. This review will include at least the following elements:

- a. Is the "package" a special capability peculiar to GE?
- b. GE cost
- c. Compatibility with Manufacturing schedules
- d. Status of Design with regard to schedule
- e. Complexity of interfaces
- f. Available manpower
- g. Available equipment
- h. Special test requirements including:
  - 1. Product Requirements (quality, reliability, schedule, etc.)
  - 2. Relative Costs

3. Subcontractor/Vendor Capability and Capacity
4. Small Business Participation and Labor Surplus Area
5. Design status and complexity of interfaces
6. Major fluctuations in employment levels

#### 6.4.5 VENDOR SURVEYS

Based on work done during Phase B potential vendors have been identified for their unique competence to augment GE's system capability. Specifically surveyed were commercial firms with capability in biomedical and behavioral fields and the status of their products was analyzed against the degree to which they are space qualified, operational, packaged, developed, or conceived. This activity will continue during Phase C as the definition of IMBLMS is further refined, the system divided into hardware packages, and performance and design requirements identified.

Vendor surveys include data from the following:

- Vendor data submissions and presentations
- Site surveys
- Literature searches
- GE marketing sources
- GE procurement activities
- Direct inquiries

Vendor data typically include:

- Equipment capability
  - Performance
  - Design Status
  - Test Status
  - Reliability
- Technical Manpower
- Facility capability
- Production and test manpower
- Special test equipment

#### 6.4.6 MAKE OR BUY DECISIONS

When the following tasks have been accomplished:

- Work "packages" described and reviews complete
- Vendor surveys complete
- M/B working group comparison complete
- M/B working group recommendation prepared

The M/B board will either approve a Make or Buy recommendation or direct further action. The subcontracts manager will maintain a record of the Board's decisions.

#### 6.4.7 SOURCE SELECTION BOARD

When a "Buy" decision has been made and it is established that the time is proper, both from a customer and GE standpoint, the Source Selection (S/S) Board (same membership in Phase C as M/B Board ) directs that RFP activity be initiated.

If one potential subcontractor shows unique capability and qualifies in all other subcontract requirements, a sole source selection is made. If several sources show acceptable capabilities, a list of qualified vendors is prepared and the Subcontracts group is directed to initiate RFP activity.

As a result of a competitive RFP, GE will receive proposals containing technical, cost and management elements. Upon receipt of the proposals, distribution is made to evaluators. The technical portion is sent to the technical groups for functional assessment to pre-established evaluation criteria which include the important technical requirements. The management portions are evaluated by the appropriate disciplines to pre-established standards. The cost proposal is reviewed by Finance (assist audits are initiated where necessary). Upon completion of evaluation the results are compiled by Subcontracts and a recommendation prepared and presented to the S/S Board.

When the S/S board has selected a source, negotiations and formal procurement are implemented using GE-MOL procurement policies.

SECTION 7

PHASE C INTEGRATED TEST PLAN

## SECTION 7

### PHASE C INTEGRATED TEST PLAN

#### 7.1 INTRODUCTION

##### 7.1.1 PURPOSE

The abbreviated IMBLMS Phase C program will contain at most a very small amount of exploratory testing. This activity has not been planned or costed. Therefore, an integrated test plan for phase C would not be a meaningful document. Rather, a more meaningful activity for Phase C is the preparation of an Integrated Test Plan for Phase D. This plan describes the preparation of the Integrated Test Plan which will be accomplished during Phase C.

##### 7.1.2 SCOPE

This plan defines the contractor activities associated with the preparation of an integrated test plan for Phase D during Phase C.

##### 7.1.3 SUMMARY

This plan is responsive to the need to plan, during Phase C, a complete, coherent integrated test program for Phase D which will provide maximum flight confidence at minimum cost. Key features of this effort are:

- a. Test planning is established as a program-wide effort, led and integrated by experienced test planning personnel.
- b. Test planning is scheduled, during Phase C, to proceed in step with the preliminary design process.
- c. The resulting integrated test plan will cover:
  1. All categories of testing (development, qualification, verification, and acceptance).
  2. All levels of testing (component through system).
  3. Objectives, relationships, environmental levels, and reporting requirements of all tests.

#### 7.2 REQUIREMENTS

The principal objectives and requirements of the integrated test program are described in paragraphs 7.2.1 through 7.2.3.

### 7.2.1 OBJECTIVES

Objectives of the Phase C test planning effort are:

- a. Plan a Phase D test program which provides maximum flight confidence at minimum cost.
- b. Provide as a Phase C output a plan in which the needs, objectives, levels, and relationships of all tests are documented.

### 7.2.2 SPECIFIC REQUIREMENTS

The specific requirements of the test plan are, to the depth compatible with the abbreviated Phase C program:

- a. Fulfill the intent of Apollo Applications Test Requirements.
- b. Include all testing: development, qualification, verification and acceptance.
- c. Provide an analysis of key technical requirements versus planned tests to assure that meeting of all key technical requirements as well as all specific test requirements are confirmed by test.
- d. Include time-line testing for verification of flight time feasibility.
- e. Provide a planned relationship between levels of testing (from parts through system).
- f. Identify test requirements and objectives, test levels (environments, performance extremes, etc.) test methods, test sequence, test measurements, test points required in the design, test facilities, test equipment and specimen configuration for each test.
- g. Provide for a planned test integration effort during Phase D by which the test program may be further planned, measured, and corrected results fed back.

### 7.2.3 SPECIFIC FEATURES

Specific features, coupling the test program and individual tests include:

- a. Test documentation plan for each step of the program. The development test procedures will be written in a format that can be modified for each of the later tests to assure a continuity of test data.
- b. Test milestone schedule plan for progress planning and measurement.

- c. Test program formatted to assure availability of proper management information.
- d. Flow of test results, derived data and corrective action recommendations needed to assure a complete integrated test program.
- e. Identify test program roles for each test. This will include test responsibility, performing group and reviews and approvals of plans and results.

### 7.3 ORGANIZATION

Figure 7-1 shows the organization of the test planning effort during Phase C.

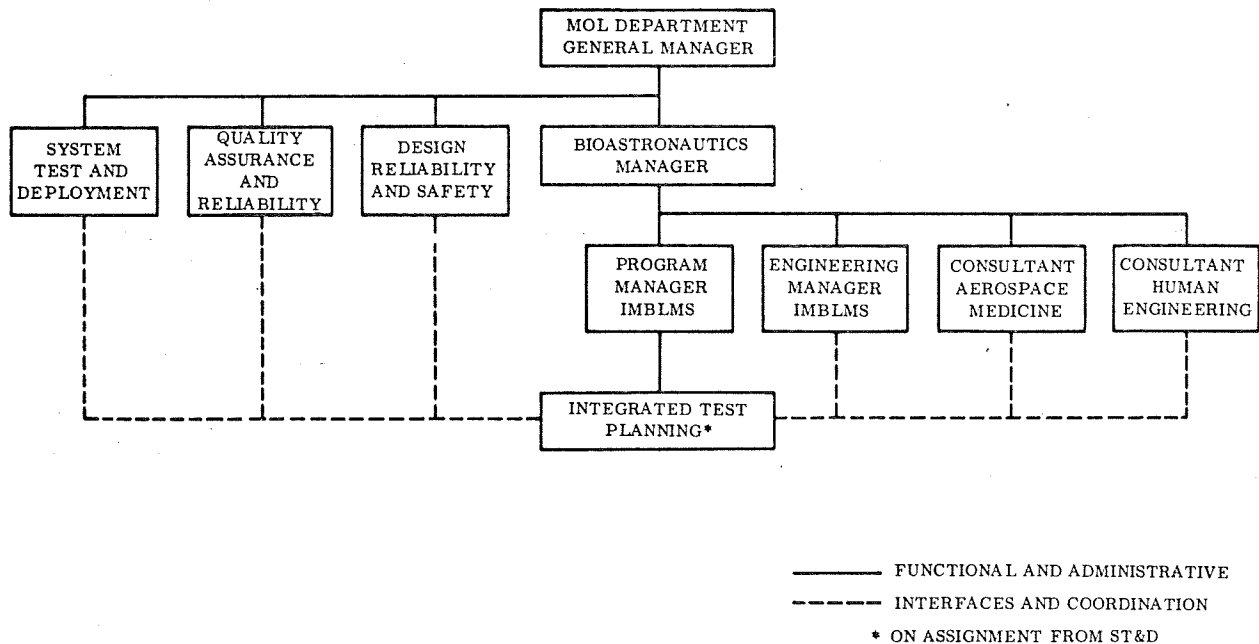


Figure 7-1. IMBLMS Phase C Test Planning Organization

### 7.3.1 PROGRAM MANAGER

The responsibility for preparation of an integrated test program lies with the Program Manager.

### 7.3.2 ENGINEERING, AEROSPACE MEDICINE CONSULTANT, HUMAN FACTORS CONSULTANT, QUALITY ASSURANCE AND RELIABILITY, SYSTEM TEST AND DEPLOYMENT, DESIGN, RELIABILITY AND SAFETY.

Each performing group is responsible to contribute its testing requirements and recommendations and to participate in the integration and trade-off of these inputs to provide an integrated plan.

### 7.3.3 SYSTEM TEST AND DEPLOYMENT

During Phase C, this group will also act as an adjunct of the Program Office to integrate and assemble the Integrated Test Plan.

During Phase D, they will contribute in accordance with 7.3.2 above; a Test Planning function will be established in the Program Office.

## 7.4 PLAN

### 7.4.1 IMPLEMENTATION

Figure 7-2 shows the schedule for integrated test plan preparation during the Phase C program.

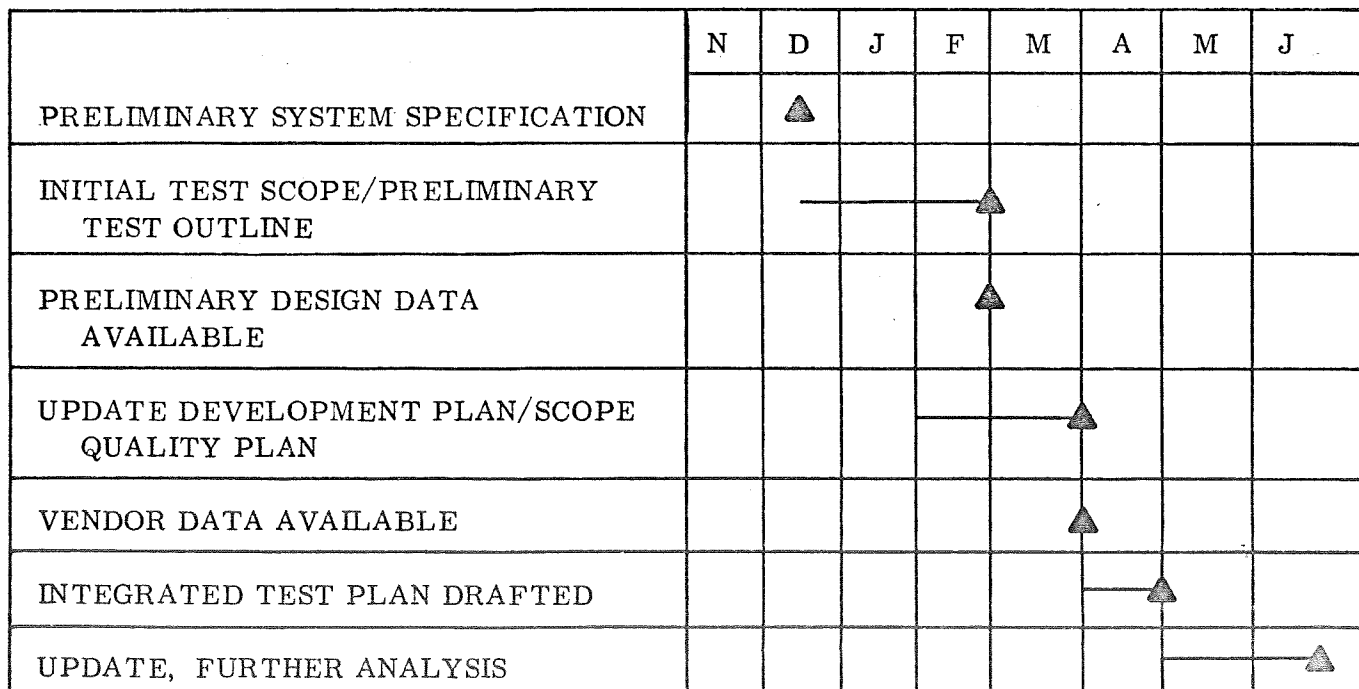


Figure 7-2. Integrated Test Plan Schedule

#### 7.4.2 TEST PLANNING STEPS

The steps in test planning during Phase C are given in the following paragraphs.

##### 7.4.2.1 Initial Scoping/Preliminary Development Test Outline

This period will be used to scope the magnitude of the testing needed for each measurement and establish a preliminary development test outline. This outline for the development test will contain as a minimum the following data:

- a. Level of equipment to be tested.
- b. Test objective for each equipment item.
- c. Preliminary test requirements for each item. This work will be added to and updated through vendor response.

##### 7.4.2.2 Update Development Plan/Scope Qualification Plan

The next step starts after the release of the preliminary design. Further information can be added to the development test plan and the Qualification Test Plan can be scoped. This plan will contain the following:

- a. Equipment to be Qualified.
- b. Number required.
- c. Probable location of test - in-house or vendor.
- d. Qualification requirements and limits. A major update of this plan will occur at the completion of vendor response since improved definition of specific hardware and test locations are available at that time.

##### 7.4.2.3 Initial Test Plan Drafted

With receipt of vendor data and further in-house design definition, the test can be narrowed down toward specific hardware.

At this time the test matrix can be completed and hardware requirements identified and tied to specific tests, compatible with the preliminary design status. Inputs to preliminary CEI specifications may be prepared. In addition, an integrated test program schedule can be completed. The schedule shall include the following:

- a. Preparation and Approval of Test Plans
- b. Preparation and Approval of Test Procedures

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- c. Test Equipment Design, Fabrication and Checkout
- d. Test Setups
- e. Testing
- f. Quick-look Test Reports
- g. Test Reports

The major effort in the validation and acceptance test plan will be to establish flight requirements and integrate the individual development and qualification test plans into an integrated plan to meet these requirements. This assures a continuity of test data and eliminates the need for further qualification tests to meet changing requirements. The acceptance tests will be prepared to meet the requirements of all flight vehicles identified but specific tests such as electromagnetic compatibility and maintainability will have to be modified to meet each equipment configuration.

#### 7.4.2.4 Update Documents/Planning Analyses

This period will be used to update the Integrated Test Plan. Vendor response will be evaluated for vendor test capability, hardware specification, and proposed vendor qualification tests. This will provide the inputs necessary to integrate the various measurements into an integrated system and assure the most efficient utilization of test personnel, facilities and equipment. NASA test review inputs would be most beneficial during this period and would assure that the IMBLMS package could be integrated into the flight vehicle test plan with a minimum of effort. For example, launch pad requirements information could be exchanged to exclude the possibility of any conflicts between the IMBLMS test requirements and that of the flight vehicle.

#### 7.4.3 INTEGRATED TEST PLAN/PREPARATION PLAN OUTLINE

- a. Test Matrix
  - 1. Equipment to be Tested
  - 2. Test Requirements and Specifications
  - 3. Test Matrix

(Requirements versus test to verify design meets these requirements.)

b. Development Test

1. Equipment to be Tested
2. Test Requirements and Specification Limits
3. Test Procedures
4. Reporting Plan
5. Milestone Schedule
6. Test Equipment and GSE Requirements
7. GSE Validation Plan and Procedure
8. Location and Facility Requirements

c. Qualification Tests

1. Equipment to be Qualified
2. Specifications for Measurements
3. Test Requirements and Procedures Based Upon Development Testing and Specification Requirements
4. Location and Facility Requirements
5. GSE and GSE Validation Plan
6. Reporting Plan
7. Milestone Schedule

d. Verification Test

1. Equipment to be Tested
2. Specification for Each Measurement
3. Test Requirements and Test Procedures Based Upon Validation Tests and Specification Requirements
4. Reporting Plan
5. Milestone Schedule

6. GSE Requirement and Validation Plan
  7. Location and Facility Requirements
  8. Test Crew Training Requirements
- e. Acceptance Tests
1. Equipment and Acceptance Specifications
  2. Integrated Test Procedures Based Upon Previous Tests
  3. Reporting Plan
  4. Milestone Schedule
  5. GSE Requirements and Validation Plan
  6. Location and Facility Requirements
  7. Test Crew Training Requirements

SECTION 8  
IMBLMS RELIABILITY PLAN

## SECTION 8

### IMBLMS RELIABILITY PLAN

#### 8.1 INTRODUCTION

This plan describes the reliability effort to be conducted by the General Electric Company, MOL Department during the Integrated Medical and Behavioral Laboratory Measurement Study, Phase C. The plan has been prepared using NHB 5300.5 as a guide for applicable tasks as defined in the statement of work.

#### 8.2 OBJECTIVES

The reliability program will be directed towards assuring:

- Inherently reliable design
- Optimum trade-off considerations with safety and maintainability
- Definition for preparation of specifications, supplier reliability requirements, and selected parts, materials, and processes lists.

#### 8.3 ORGANIZATION

Figure 8-1 shows the organizational relationships used in implementing the Reliability Plan.

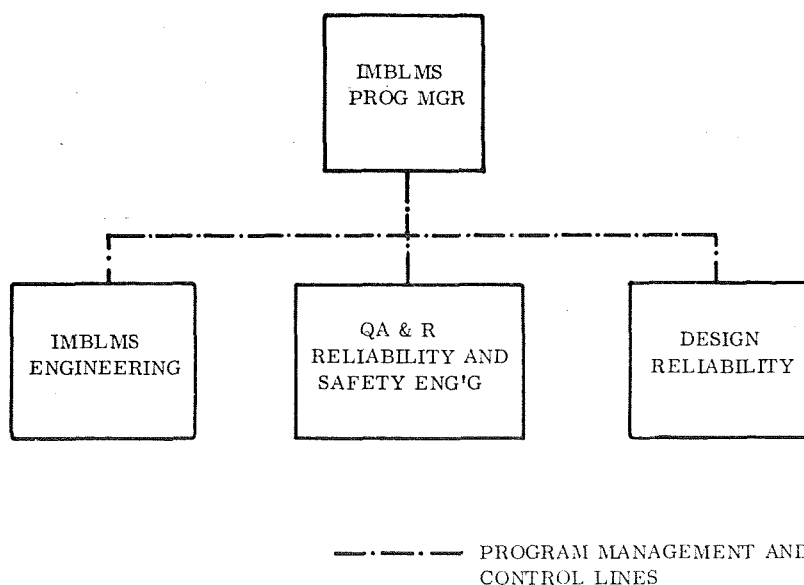


Figure 8-1. Phase C Reliability Organization

### 8.3.1 IMBLMS ENGINEERING

Reliability responsibilities include:

- System Requirements
- Subsystem Apportionment
- Effectiveness Trade Studies
- Data Requirements
- Effecting Evaluation Recommendations

### 8.3.2 QUALITY ASSURANCE AND RELIABILITY

Reliability and Safety Engineering Phase C responsibilities include:

- Reliability Program Plan
- Integrated Test Program Board
- Failure Modeling
- Failure Modes and Effects Analysis
- Materials and Processes

### 8.3.3 DESIGN RELIABILITY

Phase C responsibilities include:

- Design Standards
- Apportionment below Subsystems
- Reliability Figure of Merit Analysis and Prediction
- Parts Selection and Application

## 8.4 TASKS

### 8.4.1 RELIABILITY GOALS AND APPORTIONMENT

As early as feasible in Phase C, a study will be conducted to establish a realistic, quantitative reliability goal for the IMBLM System. A reliability apportionment will then be conducted to allocate quantitative reliability objectives to individual subsystems and sensors. The apportionment will be based on factors such as, the amount of data lost in the event of a failure, complexity, state of the art, environmental conditions, and duty cycle. The apportioned values will serve as goals for in-house equipment designs and supplier reliability requirements.

#### 8.4.2 RELIABILITY PREDICTION AND ESTIMATION

A system reliability model will be prepared in Phase C, and reliability predictions computed for comparison with the goal. Since detailed design information will be available only to a limited extent during Phase C, the predictions will identify only significant problems at the equipment or subassembly level. If such problems are identified, a corrective action plan will be developed. Implementation will be either in Phase C or planned for Phase D, depending on when the problem is identified.

The reliability model and prediction will be updated when design changes are made, with the final iteration reflecting the design at the conclusion of Phase C.

#### 8.4.3 FAILURE MODE, EFFECTS, AND CRITICALITY ANALYSIS (FMECA), AND SINGLE FAILURE POINTS

The FMECA is a major element of the reliability program. The IMBLM System will be examined for all failure modes which can occur. The causes of these failure modes will be established and the effect on system performance determined. The failure modes are then ranked for criticality based on their impact on system performance (i. e. loss of data) and the probability of occurrence. By this means, single failure points are identified.

A corrective action plan will then be instituted to eliminate or reduce the effect of single failure points and other failure modes with priority given to the most critical items.

During Phase C, the FMECA will be performed from the system level down to the major component level. It will be prepared initially during Phase C and kept current throughout the program.

At the conclusion of Phase C, a Single Failure Point Summary Report will be prepared which will identify all single failure points with criticality categories 1 and 2 (as defined in NHB 5300.5) and will include the rationale for retention of these items in the system.

#### 8.4.4 TRADE STUDIES

Reliability considerations will be an inherent part of trade studies conducted during Phase C. These will include computation of relative reliability predictions where applicable, and will in every case include FMECA's on alternate design approaches with specific attention to single failure points.

#### 8.4.5 SELECTED PARTS, MATERIALS, AND PROCESSES LISTS

Two program oriented parts lists will be developed during Phase C. One list will cover electronic and electromechanical parts; the other list will cover mechanical parts. The initial lists will include only those parts preferred for use on the program. Both lists will be mandatory for use on the program and will serve as program control documents. As the

need develops for additional parts, they will be added to the lists. The list on electronic and electromechanical parts will include:

- a. Application notes
- b. Derating requirements
- c. Part data requirements
- d. Lot traceability requirements
- e. Non-standard part requirements
- f. Part screening and burn-in requirements, where applicable

The list on mechanical parts will consist of preferred hardware selected for broad usage and finishes consistent with the program requirements.

In addition, selected materials and processes lists will be prepared based on flight proven or fully qualified items with emphasis placed on reliability and safety consideration. These lists will use the COMAT data bank as a basis.

SECTION 9  
PRELIMINARY QUALITY PROGRAM PLAN

## SECTION 9

### PRELIMINARY QUALITY PROGRAM PLAN

#### 9.1 INTRODUCTION

This Preliminary Quality Program Plan describes the quality program to be undertaken by the General Electric Company MOL Department in the fulfillment of its proposed contract with the National Aeronautics and Space Administration for the Integrated Medical and Behavioral Laboratory Measurement System Phase C Program. This plan is compliant with the customer's Statement of Work, NASA Specification NPC 200-2 (April 1962), the General Electric Company Product Quality Policy, Missile and Space Division Instructions, and the MOL Department Instructions. The quality system is designed to provide effective quality activities, resulting in quality end items in all phases of the contract, from customer specifications through design, procurement, manufacture, test, and flight.

The Phase C Quality Program Plan will incorporate all of the quality related specifications and documents negotiated in the final Phase C contract. This Quality Program Plan will be revised during the Phase C effort to include requirements for the Phase D Program. The Quality Program Plan will be submitted for customer approval. Any changes made to the Quality Program Plan due to program redirection or interpretation will be negotiated with the customer and submitted for approval prior to application on the program.

During Phase C, required monthly quality reports will be submitted as a contribution to the monthly program progress reports.

#### 9.2 QUALITY PROGRAM MANAGEMENT AND INTEGRATION

##### 9.2.1 MANAGEMENT CONCEPTS

The Quality Assurance and Reliability Section (QA&R) Manager is responsible to the MOL Department General Manager for the management, implementation and fulfillment of all Quality Assurance and Reliability activities and decisions related to the MOL Department.

Product quality and reliability results from the collective efforts of all of the department sections involved in the design, procurement, fabrication, and test of the contract end items. Each involved Section Manager is responsible to the General Manager for the excellence of his own activities. The Manager of QA&R is responsible for the overall Quality Program Plan. The remainder of this section describes the current QA&R management structure and modus operandi.

The accomplishment of the Program Quality Assurance objectives is dependent upon concepts, actions, measurements, and controls which are closely related. However, the skills and approaches used by each of these disciplines to achieve its objective are quite different. The placement of these activities at equal levels within the QA&R Section recognizes this fact.

Key elements of the IMBLMS Quality Program include:

- a. The integration of quality and reliability considerations, necessitated by long life manned missions, into hardware designs and specifications.
- b. Vendor Quality and Reliability Control.
- c. Frequent and repetitive measurement and evaluation during procurement, manufacturing, and assembly cycles.
- d. Concentration and detailed attention on early planning for parts, materials, processes, applications, and controls.
- e. Closed loop systems for prompt failure detection, failure analysis, reporting, timely corrective action, and followup.
- f. Participation in or conductance of prime hardware testing from development tests through acceptance tests.
- g. Continuous and thorough measurement of the reliability status of hardware through evaluation and analysis of performance data.
- h. Configuration verification.
- i. Traceability on piece of parts and materials to the lot number.

#### 9.2.2 QUALITY ASSURANCE AND RELIABILITY ORGANIZATION

The QA&R Section is subdivided into operations which have been functionally oriented to most efficiently serve the overall quality and reliability requirements of the Department Programs. It is planned that the IMBLMS Program QA&R requirements will be fulfilled within this functional framework.

The responsibilities and activities of each of the QA&R Operations are briefly described in the following paragraphs.

##### 9.2.2.1 Project Engineering

Responsible for the interpretation, evaluation and dissemination of contractual and project requirements and plans; for project management technical direction and integration within QA&R; for project planning, measurement and control; and for project budgets, schedules, documentation and costs. Responsible for the development and preparation of Program Plans and Cost Estimates; for project manpower and workload projections; for facility loading and requirements; and for negotiating contract funding with the Program Manager. Responsible for providing direction within QA&R for implementation of the Program Plans within budgets and schedules; for cost, schedule and technical performance measurement of performance versus plan; for reporting project status and for negotiation and integration with other Sections

other than the Development Subcontracts Section, for program implementation. Responsible for a customer hardware buyoff program; project technical security requirements and implementation; ST&D field and logistic support; and for management reports such as PAR based on Department PAR. Responsible for operations control management, section security, and administrative matters.

#### 9.2.2.2 Quality Control Engineering

Responsible for the planning, establishing, conducting and reporting quality engineering and test activities during all program stages from preliminary design through acceptance. Prepare Quality Plans; establish test and test equipment requirements; delineate supplier quality control; and serve as the principal quality interface with Design Engineering. Provide Departmental and Supplier quality motivation. Provide Section representation in Design Review, Change Control, Integrated Test Program, and EMC Boards. Develop critical component quality assurance requirements. Coordinate, review, and approve for the Section all Design Engineering fabrication drawings, specifications, and standards. Provide test planning and direction; operate laboratories; perform flight equipment acceptance and qualification of components and subassemblies, conduct GSE CEI validation and acceptance, and assist in the conduct of development tests. Plan and direct in-house part and module testing; perform module testing.

#### 9.2.2.3 Reliability and Safety Engineering

Responsible for the establishment of the Reliability Program Plan, implementation of supplier reliability management, performance of failure modes and effects analyses and establishment of Mission Critical Component Plans. Responsible for establishing a reliability and availability measurement system, reliability test and Dynamic Mission Equivalent requirements, providing statistical services to the Department, and a Failure Analysis, Reporting and Corrective Action System, including the Failure Analysis Board and Failure Flow Modeling. Responsible for providing Reliability Education Program, performing safety analysis and measurement, including Hazard Modes and Effects Analysis, and assuring a closed loop corrective action system to reduce safety risks; operating a quality evaluation system, and establishing the ITPB (Integrated Test Program Board) Chairman, who is directly responsible to the Department General Manager. Responsible for establishing and operating the Department Performance Data System and data bank including collecting, processing, storing, and analyzing test, inspection, configuration verification, quality, and reliability data from supplier, in-house, and off-site locations. Provide QA&R Section members for the Reliability Policy Board and the Systems Safety Engineering Board.

#### 9.2.2.4 Quality Equipment Engineering

Responsible for the design, development, procurement, fabrication, installation, modification and checkout of test equipment for development, qualification and acceptance level testing of parts, modules, components, subsystems and systems and for QA&R facilities. Responsible for providing evaluation equipment and test facility operating procedures, calibration instructions, maintenance manuals, test operator training and certification, instrument pool

and control, and maintenance and calibration services for all Departmental measurement equipment and instrumentation, and for operating Departmental Instrument Calibration, Maintenance, Repair and Test Equipment Development Laboratories. Responsible for providing resources, functional space and facilities requirements; space and equipment integration with Facilities and other Department Sections; planning and design for QA&R Laboratory and test areas; test equipment design information and consultation service to other MOL Sections and MOL suppliers, and for serving as the QA&R representative on the Department's Appropriation Review Board.

#### 9.2.2.5 Materials and Processes Engineering

Responsible for providing and operating a capability for complete materials and processes engineering and materials acceptance; supporting engineering development programs; developing existing and new materials and processes for advanced applications; performing materials and processes studies; and providing engineering information on materials and processes to the Department. Responsible for providing and operating a capability for the complete testing and evaluation of materials and processes; materials and processes engineering; performing materials performance and failure analysis; analyzing and evaluating products to determine materials suitability and performance; and issuing approved materials and processes lists for Department and supplier applications. Responsible for the operation of sample preparation, chemical, metallurgical, nondestructive, mechanical test, and other test laboratories; for operation of the Department Failure Analysis Teardown Laboratory; issuing of materials and processes handbooks, bulletins, instructions, specifications and standards for in-house and for suppliers' applications, and for in-house and suppliers' operators, processes and material warehouse certifications. Provide Chairmanship of Department Contamination Control Board.

#### 9.2.2.6 Supplier Product Integrity

Responsible for planning, implementing and maintaining the activity related to assuring that Quality, Reliability, Safety and Maintainability requirements are met by vendors and subcontractors. Responsible for providing assistance to the Procurement and Subcontract Management activities in selecting and managing suppliers and for taking effective and timely corrective action on procured hardware. Provide the primary QA&R interface with the Development Subcontracts Management Section and the Manufacturing Purchasing Operation. Participate in hardware and software acceptance and buyoff at the suppliers' facilities. Perform all receiving inspection planning and inspection at the in-house facility. Develop and maintain a Supplier Quality Rating Program. Execute QA&R resident and visiting engineering and vendor surveillance activities.

#### 9.2.2.7 Quality Systems and Product Assurance

Responsible for assuring adequacy of the quality of the product being manufactured; providing Process Control Engineering technical coverage in all Manufacturing areas; Inspection planning for all prime hardware; In-Process Inspection for Manufacturing Shops, Final Assembly, System Test and Shipping. Responsible for developing and implementing a complete Configuration Verification System; a hardware maintainability system; and a total non-conformance

material control program including establishment of and Chairman for a Material Review Board (MRB) for the Customer. Responsible for collecting, categorizing and compiling data for the CEI Log Books for Customer Product Buyoffs; providing for contamination control in all areas; formulating Inspection Criteria and Standards for manufactured hardware; and establishing procedures for and performing all mechanical alignments during Final Assembly and Systems Test. Responsible for establishing and maintaining a complete QA&R Quality System for all suppliers and for all GE sites, including the Quality Control and Reliability Operating Procedures Manual; the Quality Reliability and Safety Appraisal and Audit Program to assure Department and supplier compliance to Quality and Reliability requirements; for Quality education, and for maintaining DCASR Quality Assurance Division liaison. Provide QA&R Section member for Department Audit Board. Responsible for providing Vehicle Product Conformance Engineering at each GE site.

### 9.3 DESIGN AND DEVELOPMENT SUPPORT

Quality requirements will be implemented during the design and development phase. During the design/development period, responsible quality engineers will develop the specific quality plans for the IMBLMS equipment. In addition, the quality engineers will be responsible for coordination with the design engineers to assure the inclusion of quality aspects in the design definition.

#### 9.3.1 DESIGN EVALUATION

The design review provides a potent means of assuring that adequate consideration has been given to quality during the early design. The design review procedure is a continuing one and design reviews will be scheduled through the design and test phases.

During Phase C, the design as documented by preliminary CEI Part I Specifications, Environmental Specifications, Interface Specifications, and a Stage I Engineering Design Release will be reviewed in detail by Quality Control, Reliability and Safety, and Materials and Process Engineers.

The Quality Assurance and Reliability participation in this Design Review will be to consider items such as:

- a. Is the design amenable to inspection at various levels of assembly?
- b. Does the design lend itself to testing at the various levels of assembly?
- c. Have electromagnetic compatibility requirements been adequately specified and considered?
- d. Has the reliability failure mode analysis activity indicated specific quality requirements that have not been documented?
- e. Will new process specifications and training courses have to be established?

The continuing design review activity is enhanced by maintaining a close day-to-day working relationship between the cognizant quality and design engineers. The quality engineer participates with the design engineer in the preparation of test requirements for incorporation into equipment specifications. In addition, the quality engineer is charged with responsibility to impose quality discipline at all levels of design. Quality engineers provide close and continuous support to individual design engineers to ensure proper consideration of quality factors in their design tradeoffs and effective utilization of quality analysis tools in arriving at an adequate design. Subsequently, the quality engineer will prepare and issue a quality plan for selected articles specifying the inspection criteria, test requirements and, as applicable, supplier quality and reliability requirements.

### 9.3.2 MATERIAL AND PROCESS SELECTION

Materials and Process Engineers, in particular, will review preliminary designs for usage of approved material. This review is to ensure proper application of materials and processes; to ensure that specifications are available for critical materials and processes or that provisions are made to write and issue them, and to determine when evaluation or concurrent development tests are required.

Selected Materials Lists and Selected Processes Lists will be compiled utilizing the COMAT data bank (materials data obtained by MSC from White Sands in support of the Apollo program). The materials selected have all been tested for suitability in space environments and pass the desirable characteristics of low outgassing rates, self-extinguishing, and low evolution of toxic products and odors.

Processes selected have all been tested to insure that the end item produced by that process is suitable for space environments. Where materials and/or processes that are not in the COMAT listings are required, they will be tested to the requirements of MSC-A-D-66-3, Rev. A (5 June, 1967). This testing activity will be part of the IMBLMS Phase D effort.

### 9.3.3 DEVELOPMENT AND QUALIFICATION TEST PROGRAM

The preliminary requirements established during Phase C for the Development Test Program and the Qualification Test Program will be reviewed by Quality Assurance and Reliability Engineers to assure adequacy of the proposed test programs to verify that the design meets the specified needs of the program.

## 9.4 CONTROL OF PROCURED MATERIAL

The control of procured articles will be initiated early in the design and development cycle. NPC 200-2 and NPC 200-3, in combination with the General Electric documents, will be used to specify the program quality requirements for procured articles.

To insure supplier compliance with the contract provisions, preaward surveys, conferences, source surveillance, and quality audits will be employed according to the overall planning for each procured article. Correlation studies will be conducted on a continuous basis between the source and in-house data for assurance of consistent quality measurements.

#### 9.4.1 PHASE C PROCUREMENT ACTIVITIES

General Electric has established and will require suppliers to establish a system which ensures that all procurement sources are evaluated and approved prior to issuance of the purchase orders or subcontracts. Quality approval will be based upon the supplier's quality history, or a survey report. Prior to award, each selected supplier must satisfy one of the following conditions:

- a. Have a quality record of supplying high quality articles of the type being procured. These quality data, accumulated and analyzed by QA&R will be in the form of qualitative and quantitative information based on objective evidence and will be documented in a monthly supplier quality rating report.
- b. If no up-to-date rating is available, a survey of the supplier's facilities and quality control system will be accomplished. The survey must indicate that the supplier has the capability to supply articles which meet all quality requirements. The supplier's manufacturing capability, his system for controlling hardware quality, methods for measuring achieved hardware quality, test and inspection capability, handling methods and other factors influencing quality will be evaluated.

When commercial or off-the-shelf items are to be procured and no quality history on the supplier is available, the decision to conduct a survey will be based upon the following considerations:

- a. End use of the item (criticality)
- b. The probability of latent defects. Are defects detectable by receiving inspection?
- c. The procurement lead time. How long does it take the supplier to replace items rejected by receiving inspection?

#### 9.4.2 PROCUREMENT DOCUMENT CONTENTS

Quality and reliability requirements for items identified during Phase C to be of a critical or major nature will be documented on a Quality Assurance and Reliability Provisions form (QARP). Quality requirements for the remaining hardware categories will be established by incorporation of all or the applicable portion of GE Document No. 64SD919, "Vendor Quality Control Instructions" into the procurement document.

All subcontracts and purchase orders issued during Phase D will contain provisions for the following, as applicable.

- a. Engineering Specification - Will be referenced on the purchase order or subcontract and will become part of the procurement package. The specification will delineate design and test requirements for the article.

- b. Quality Assurance and Reliability Requirements - General Electric documents, and NPC 200-2 or NPC 200-3 will provide the basic requirements.

#### 9.5 QUALITY ASSURANCE AND RELIABILITY OPERATING PROCEDURES

The Quality Assurance and Reliability Section has developed and maintains a set of Quality Assurance and Reliability Operating Procedures that define the approved methods of operation to assure conformance to program and company requirements.

During Phase C, these procedures will be reviewed in detail with respect to NASA requirements. Any areas requiring revision will be identified and plans will be established to assure that these revisions are in force during Phase D of the IMBLMS program.

#### 9.6 PHASE D QUALITY PROGRAM PLAN

This Quality Program Plan will be revised during Phase C to cover all planned Phase D activities. In addition to expanding paragraphs 9.3 and 9.4, sections will be included for:

- a. Control of Government Furnished Property
- b. Control of Contractor - Fabricated Articles
- c. Nonconforming Materials
- d. Inspection, Measuring, and Test Equipment
- e. Inspection Stamps
- f. Preservation, Packaging, Handling, Storage and Shipping
- g. Training and Certification of Personnel
- h. Data Reporting and Corrective Action
- i. Audit of Quality Program Performance

SECTION 10  
SPECIFICATION PLAN

## SECTION 10

### SPECIFICATION PLAN

#### 10.1 INTRODUCTION

##### 10.1.1 PURPOSE

This plan describes the IMBLMS Specification development program which will be conducted during Phase C. It is based on the requirements of the uniform specification program defined in NPC 500-1 and the applicable exhibits therein.

##### 10.1.2 SCOPE

This plan identifies the type of specifications which will be developed, identifies the organizations responsible for their preparation, and the preparation schedule. It also presents a generic specification tree (Figure 10-1) which will be expanded during Phase C as hardware is identified.

##### 10.1.3 SUMMARY

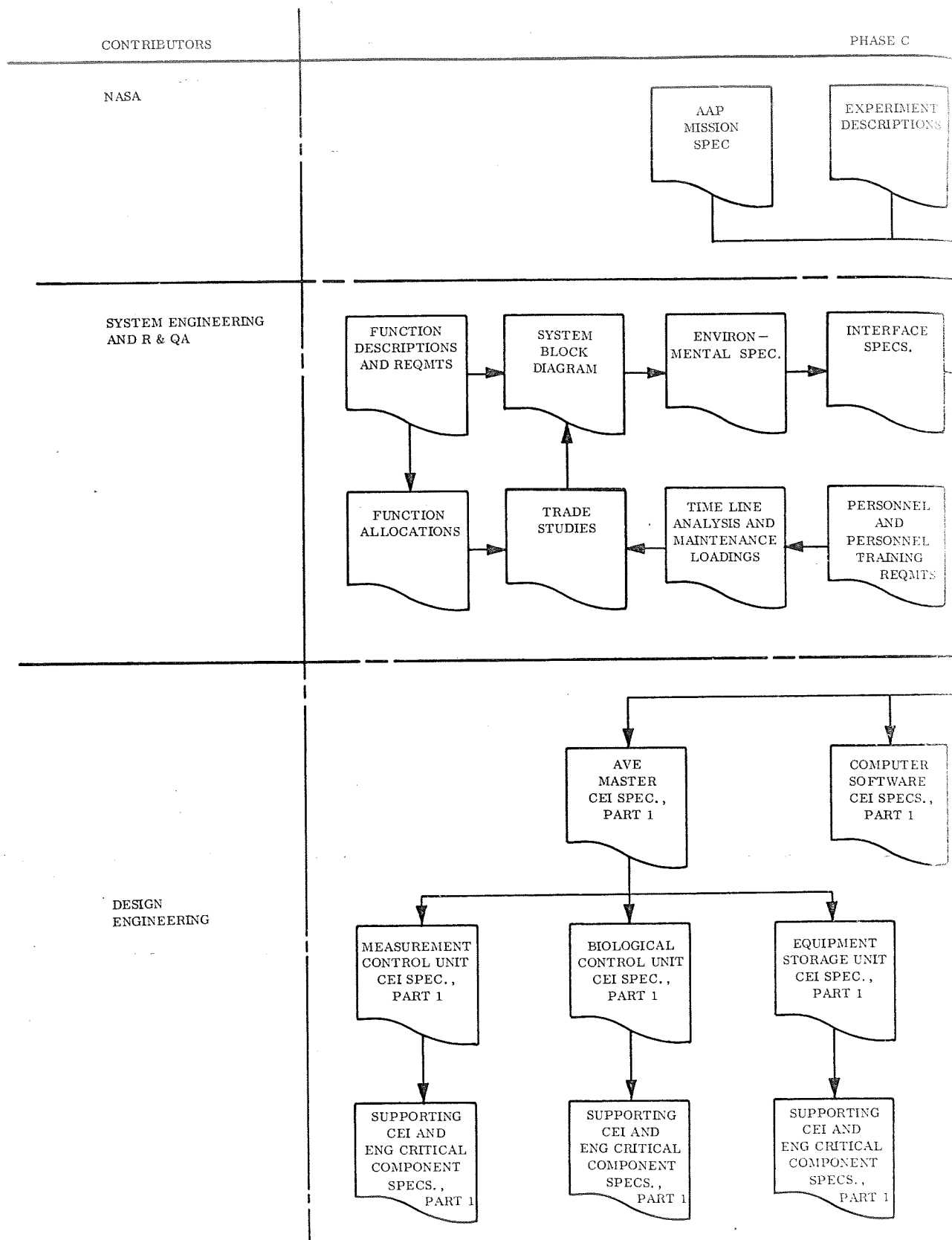
Key features of this plan are:

- Responsible to the NASA configuration Management Manual NPC 500-1 and the applicable exhibits therein.
- Specifications will be developed in logical sequence in order to assure compatibility of requirements.
- Requirements specified in the Part I will be compatible with the requirements of the NASA input documents, such as AAP Mission Specification, Experiment Descriptions, Vehicle Specifications, Interface Documents, GFE and GFP Specifications, Work Statement, etc.

#### 10.2 OBJECTIVES

The objectives of the specification development program during Phase C are as follows:

- Identify all items of the IMBLMS system which are properly classified as Contract End Items or Engineering Critical Components.
- Prepare the Part I portions of the specifications making full use of available input material.
- Have as many of the Part I portions of the specifications as possible available in rough draft form, at the midterm review.



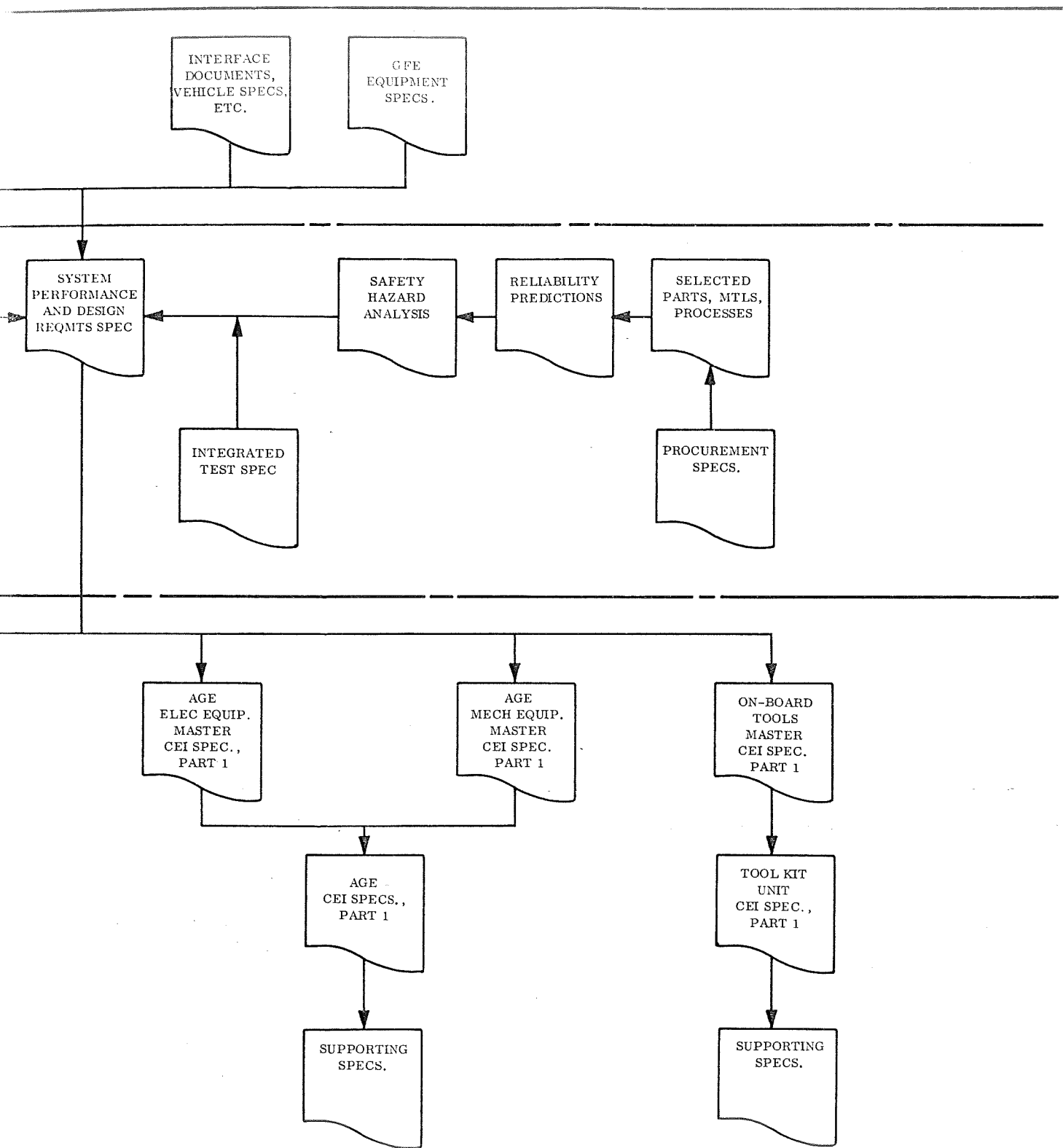


Figure 10-1. IMBLMS Phase C  
Specification Tree

- Update, refine, and complete all Part I specifications of identified hardware by the end of month six.

### 10.3 ORGANIZATION AND RESPONSIBILITIES

10.3.1 Engineering is responsible for the preparation of all CEI and Engineering Critical component Specifications with other organizations responsible for assistance and review as applicable.

10.3.2 The Program Manager will approve all CEI Specifications prior to their submittal for customer review and approval.

### 10.4 IMPLEMENTATION

Specification Plan implementation is shown in Figure 10-2.

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	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
SPDR				△										△	(UPDATE)													
MASTER CEI																										△		
OTHER CEI'S																												
IDENTIFY							△																					
REVIEW AT CONCEPT DESIGN REVIEW													△															
PART I'S																										△		

Figure 10-2. Specifications Schedule

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